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Coal Combustion Waste Impoundment
Round 6 - Dam Assessment Report

Vermilion Power Station (Site 015)

Fly Ash Dikes
Dynegy Midwest Generation, Inc.
Oakwood, Illinois

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

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INTRODUCTION, SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The release of over five million cubic yards from the Tennessee Valley Authority's Kingston, Tennessee facility in December 2008, which flooded more than 300 acres of land, damaging homes and property, is a wake-up call for diligence on coal combustion waste disposal units. We must marshal our best efforts to prevent such catastrophic failure and damage. A first step toward this goal is to assess the stability and functionality of the ash impoundments and other units, then quickly take any needed corrective measures.

This assessment of the stability and functionality of the Vermilion Power Station Fly Ash Dam management units is based on a review of available documents and on the site assessment conducted by Dewberry personnel on Tuesday, August 10, 2010, as well as data submitted subsequent to the site visit. We found the supporting technical documentation adequate for the East Ash Pond System (Section 1.1.3).

In summary:

- The East Ash Pond System is FAIR for continued safe and reliable operation, with no recognized existing or potential management unity safety deficiencies.
- The North Ash Pond System is not rated.

PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA) is embarking on an initiative to investigate the potential for catastrophic failure of Coal Combustion Surface Impoundments (i.e., management unit) from occurring at electric utilities in an effort to protect lives and property from the consequences of a dam failure or the improper release of impounded slurry. The EPA initiative is intended to identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures (if present); to note the extent of deterioration (if present), status of maintenance and/or a need for immediate repair; to evaluate conformity with current design and construction practices; and to determine the hazard potential classification for units not currently classified by the management unit owner or by a state or federal agency. The initiative will address management units that are classified as having a Less-than-Low, Low, Significant or High Hazard Potential ranking. (For Classification, see pp. 3-8 of the 2004 Federal Guidelines for Dam Safety)

In February 2009, the EPA sent letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion waste. This letter was issued under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e), to assist the Agency in assessing the structural stability and functionality of such management units, including which facilities should be visited to perform a safety assessment of the berms, dikes, and dams used in the construction of these impoundments.

EPA requested that utility companies identify all management units including surface impoundments or similar diked or bermed management units or management units designated as landfills that receive liquid-borne material used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

The purpose of this report is to evaluate the condition and potential of waste release from the selected Coal Combustion Waste (CCW) management units. This evaluation included a site visit. Prior to conducting the site visit, a two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit hazard potential classification (if any) and accepted information provided via telephone communication with the management unit owner.

Factors considered in determining the hazard potential classification of the management units(s) included the age and size of the impoundment, the quantity of coal combustion residuals or by-products that were stored or disposed of in these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s).

LIMITATIONS
The assessment of dam safety reported herein is based on field observations and review of readily available information provided by the owner/operator of the subject coal combustion waste management unit(s). Qualified Dewberry engineering personnel performed the field observations and review and made the assessment in conformance with the required scope of work and in accordance with reasonable and acceptable engineering practices. No other warranty, either written or implied, is made with regard to our assessment of dam safety.

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1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from a one-day site visit on August 10, 2010, and review of technical documentation provided by Dynegy.

1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

The New East Ash Pond system did not indicate any areas of significant concern during the one-day site visit. The impoundment dam is under the regulatory authority of the State of Illinois Dam Safety program and has had no significant adverse findings in prior State inspections.

Review of the structural stability analysis indicated some potential issues related to stability in the event of short term loading conditions including rapid draw down, rapid increase in ash loading in the pond, and selection of the seismic event.

- The analyses evaluated only long term stability using long term, drained soil strength data. A short term, post-construction event can produce short term increases in soil pore pressure and a corresponding decrease in shear strength. This phenomenon can cause failure of embankments that have otherwise been stable for decades.
- The ground acceleration used in the seismic loading analysis does not meet the current recommended design criteria and should be re-analyzed using current design criteria.
- The embankment geometry used in the slope stability analysis does not appear to be consistent with the geometry indicated on the design drawings.

1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)

The New East Ash Pond System design report includes critical rainfall analyses, freeboard design, outfall design calculations, and impact on flood elevations of the Middle Fork Vermilion River. Appropriate safety considerations were applied.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

The supporting technical documentation is adequate. Engineering documentation reviewed is referenced in Appendix A.

1.1.4 Conclusions Regarding the Description of the Management Unit(s)

The description of the management unit provided by Dynegy was an accurate representation of what Dewberry observed in the field.

1.1.5 Conclusions Regarding the Field Observations

For the New East Ash Pond System, Dewberry staff was provided access to all areas in the vicinity of the management unites required to conduct a thorough field observation. The visible parts of the dike embankments and outlet structure were observed to have no signs of overstress, significant settlement, shear failure, or other signs of instability. Embankments visually appear structurally sound. There are no indications of unsafe conditions or conditions needing remedial action.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

For the New East Ash Pond System, the current maintenance and methods of operation appear to be adequate for the fly ash management unit. There was no evidence of repaired embankments or prior releases observed during the field inspection.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

For the New East Ash Pond System, the surveillance program appears to be adequate. The management unit dikes are not instrumented. Based on the size of the dikes, the history of satisfactory performance and the current inspection program, installation of a dike monitoring system is not needed at this time.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The New East Ash Pond System is SATISFACTORY for continued safe and reliable operation. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

The documentation is adequate to demonstrate structural stability of the embankment under long term loading conditions.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

No recommendations appear warranted at this time.

1.2.3 Recommendations Regarding the Supporting Technical Documentation

No recommendations appear warranted at this time.

1.2.4 Recommendations Regarding the Description of the Management Unit(s)

No recommendations appear warranted at this time.

1.2.5 Recommendations Regarding the Field Observations

No recommendations appear warranted at this time.

1.2.6 Recommendations Regarding the Maintenance and Methods of Operation

No recommendations appear warranted at this time.

1.2.7 Recommendations Regarding the Surveillance and Monitoring Program

No recommendations appear warranted at this time.

1.2.8 Recommendations Regarding Continued Safe and Reliable Operation

No recommendations appear warranted at this time.

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1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

Rick Diericx, Dynegy Midwest Generation, Inc.
Thomas L. Davis, Dynegy Midwest Generation, Inc.
Charles P. Nerone, Dynegy Midwest Generation, Inc.
Ken Berry, P.E., URS
Cleighton Smith, P.E., Dewberry
Julia Moline, E.I.T., Dewberry

1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on August 10, 2010.

Cleighton Smith, P.E.

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2.0 DESCRIPTION OF THE COAL COMBUSTION WASTE MANAGEMENT UNIT(S)

2.1 LOCATION AND GENERAL DESCRIPTION

The Vermilion Power Station is located near the Middle Fork Vermilion River near Oakwood, Illinois. A map of the site is provided in Appendix A – Doc 01. The plant is operated by Dynegy Midwest Generation, Inc. The Vermilion Power Station includes three ash pond systems: The Old East Ash Pond System, the North Ash Pond System, and the New East Ash Pond System. A labeled aerial photograph is provided in Appendix A – Doc 02.

- The Old East Ash Pond System was built as part of the original plant construction in the mid-1950's, and was taken out of service in the mid-1970's. Because the Old East Ash Pond System has not been operational since the 1970's, it was not assessed and is not discussed in this report.

- The North Ash Pond System was constructed in the mid-1970's. It is a two-cell system. Since construction of the New East Ash Pond System in 1988, the North Ash Pond System has been used primarily for stormwater storage. The North Ash Pond System is surrounded by a continuous earthen embankment, and an internal earthen dike separates the primary cell from the secondary cell. The North Ash Pond System embankment is described in design drawings (Appendix A – Docs 03, 04, 05, and 06) as being constructed with "controlled compacted fill"; other information about the embankment material is unavailable. The North Ash Pond System is not regulated by a state agency and is not discussed in this report beyond Section 2.

- The New East Ash Pond System (referred to as the East Ash Pond System for the remainder of the report) was constructed in 1988 and expanded in 2002. It is a two-cell system. The East Ash Pond System is surrounded by a continuous earthen embankment, and an internal earthen dike separates the primary cell from the secondary cell. The East Ash Pond System embankment is constructed with a minimum 8 foot clay core surrounded by compacted earth (Appendix A – Docs 07-09/Original Construction Drawings and Docs 10-15/Expansion Drawings). The East Ash Pond System is regulated by the Illinois Department of Natural Resources (DNR).

Both the North Ash Pond System and the East Ash Pond System were observed by Dewberry, and both units are described in the field observations section. However, because the North Ash Pond System is not permitted with or regulated by the Illinois Department of Natural Resources (IDNR) Dam Safety Unit, and has not been used for coal combustion waste storage since 1989, little documentation is available for that unit. Note that failure of the dike would not result in any offsite environmental release. Therefore, the North Ash Pond system is not discussed in Sections 3, 7, 8, 9, or 10 of this report.

Table 2.1a summarizes the dimensions of the embankments surrounding the East Ash Pond System[1].

Table 2.1a: Embankment Dimensions East Ash Pond	
Dam Height (ft)	48
Crest Width (ft)	15
Length (ft)	3,660
Side Slopes (upstream) H:V	3:1
Side Slopes (downstream) H:V	3:1

[1]Appendix A—Docs 10-15 and 16

2.2 SIZE AND HAZARD CLASSIFICATION

The East Ash Pond System is an intermediate size impoundment, based on Table 2.2a. It is approximately 48 feet high and has a design storage of 566 acre-feet (Appendix A—Doc 16). The North Ash Pond System was an intermediate size impoundment, based on Table 2.2a.

Table 2.2a: USACE ER 1110-2-106, Size Classification		
	Impoundment	
Category	**Storage (Ac-ft)**	**Height (ft)**
Small (East Ash Pond System)	50 and < 1,000	25 and < 40
Intermediate	***1,000 and < 50,000***	***40 and < 100***
Large	> 50,000	> 100

The East Ash Pond System is classified as having ***Significant*** hazard, based on Table 2.2b below. While loss of human life would not be expected if a failure would occur, there would be environmental losses due to the presence of the Middle Fork of the Vermilion River and the Kickapoo State Park in the immediate downstream vicinity.

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Table 2.2b: FEMA Federal Guidelines for Dam Safety Hazard Classification		
	Loss of Human Life	**Economic, Environmental, Lifeline Losses**
Low	None Expected	Low and generally limited to owner
Significant	***None Expected***	***Yes***
High	Probable. One or more expected	Yes (but not necessary for classification)

The East Ash Pond System is an intermediate, significant hazard impoundment. For the purposes of this report, the North Ash Pond System is not classified.

2.3 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY

The East Ash Pond System is designed and permitted to contain fly ash, bottom ash, boiler slag, and other materials. Key information is presented in Table 2.3b.

Table 2.3b: Maximum Capacity of Unit, East Ash Pond System	
Surface Area (acre)[1]	20
Current Storage Capacity (cubic yards)	534,013
Current Storage Capacity (acre-feet) [1]	331
Total Storage Capacity (cubic yards)	897,013
Total Storage Capacity (acre-feet) [1]	566
Crest Elevation (feet)[2]	620
Normal Pond Level (feet)[2]	582

[1]Appendix A—Doc 16

[2]Appendix A—Doc 10-15

2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankment

The East Ash Pond System consists of an earthen embankment ring dike. Design drawings indicate design of an impervious clay core surrounded by compacted fill (Appendix A—Doc 10-15).

2.4.2 Outlet Structures

The East Ash Pond System outlet structure is a 36-inch diameter concrete pipe (Appendix A—Doc 12) which discharges to a rock-lined channel, which in turn discharges to the Middle Fork Vermilion River. There is also an emergency spillway, which consists of a concrete pipe drop structure.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

There is no critical infrastructure within five miles down gradient. There is a road bridge within Kickapoo State Park about six miles downstream and an instate highway bridge about eight miles downstream.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

3.1 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS.

The East Ash Pond System was built under the Illinois Department of Transportation Division of Water Resources Permit Number 19333, dated August 23, 1988. The East Ash Pond System is currently regulated by the Illinois Department of Natural Resources Permit #DS2002056. The dam is inspected annually by a P.E. and was most recently inspected in March of 2010.

The East Ash Pond System was issued National Pollutant Discharge Elimination System Permit #IL0004057. The permit was issued on March 3, 2003 and expired on February 28, 2008. A renewal has been filed, but the permit had not been re-issued at the time of the inspection (Appendix C – Checklist).

3.2 SUMMARY OF SPILL/RELEASE INCIDENTS

Data reviewed by Dewberry did not indicate any spills, unpermitted release, or other performance related problems with the North or East Ash Pond System embankments over the last 10 years.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

The Vermilion Power Station was originally constructed in the 1950's. The North Ash Pond System was designed and constructed in the mid 1970's to replace the original ash pond system (the Old East Ash Pond System). The Old East Ash Pond was not used after the North Ash Pond System began operation.

In 1988 and 1989, the (New) East Ash Pond System was designed and constructed to replace the North Ash Pond System. In 2002, the East Ash Pond System was expanded.

4.1.2 Significant Changes/Modifications in Design since Original Construction

As noted above, the East Ash Pond System, the current operational ash pond system, is the third ash pond system to serve the Vermilion Power Station since its construction in the 1950's.

The East Ash Pond System was expanded to the current layout in 2002. The embankment height was increased and the surface area of the ring dike was expanded (Appendix A-Doc 10-15).

4.1.3 Significant Repairs/Rehabilitation since Original Construction

The North Ash Pond System embankment underwent repairs for erosion in 1988 (Appendix A-Doc 19). No significant repairs have taken place along the East Ash Pond System embankment since original construction.

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

The North Ash Pond System does not have a written operation and maintenance plan. The North Ash Pond System was originally designed and operated for fly ash sedimentation and control. The pond received plant process waste water, coal combustion waste slurry, and stormwater runoff from the pond embankments. Treated process water was discharged through an overflow outlet structure.

The East Ash Pond System has an Operation and Maintenance Plan approved by the State of Illinois under the dam safety permit. It is included in Appendix A—Doc20. The East Ash Pond System, which replaced the North Ash Pond System as the operational fly ash sedimentation and control unit, receives various plant process waste waters, bottom ash transport water, fly ash, and stormwater runoff from the pond embankments. Treated process water is discharged through an overflow outlet structure.

4.2.2 Significant Changes in Operational Procedures and Original Startup

The North Ash Pond System received sluiced ash until the mid – 1990s. Plant process waste waters, bottom ash transport water, and fly ash are no longer received by or collected in the North Ash Pond System. The North Ash Pond System is not permitted by the IDNR. Stormwater flows from the primary cell of the North Ash Pond System to the secondary cell via a portable pump. Pumping is periodic, as needed, typically after significant rainfall events.

No significant changes in the Operations Procedures were reported since original startup for the East Ash Pond System.

4.2.3 Current Operational Procedures

The North Ash Pond System continues to capture stormwater runoff from the Vermilion power station. Stormwater is pumped from the primary cell into the secondary cell as needed. Stormwater is discharged manually, as needed, into the Middle Fork Vermilion River.

Discharge from the primary cell of the East Ash Pond System to the secondary cell is via gravity overflow. Flow from the secondary cell to the Middle Fork Vermilion River is also via gravity overflow.

4.2.4 Other Notable Events since Original Startup

No additional information was provided to Dewberry concerning notable events impacting the operation of the impoundment.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Cleighton Smith, P.E. and Julia Moline, E.I.T. performed a site visit on August 10, 2010 in company with the participants.

The site visit began at 8:00 AM. The weather was cool and overcast, with occasional rain showers. Photographs were taken of conditions observed. Please refer to photographs in Appendix B and the Dam Inspection Checklist in Appendix C. Selected photographs are included herein for ease of visual reference. All pictures were taken by Dewberry personnel during the site visit.

The overall assessment of the embankments was that they were in satisfactory condition and no significant findings were noted.

5.2 NORTH ASH POND SYSTEM

5.2.1 Crest

The crest of the embankment had no signs of significant depressions, tension cracks or other indications of settlement or shear failure. A gravel service road covered the majority of the embankment. Figure 5.2.1-1 shows the typical crest conditions.

Figure 5.2.1-1: Photograph of Crest of North Ash Pond System Embankment

5.2.2 Upstream/Inside Slope

The inside slope of the North Ash Pond System embankment is vegetated with various species of tall grass and weeds. Heavy overgrowth in the primary cell of the North Ash Pond System made close observation of embankment conditions difficult. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability. Figure 5.2.2-1 shows a representative section of the inside slope of the primary cell embankment. Figure 5.2.2-2 shows a representative section of the inside slope of the secondary cell embankment.

Figure 5.2.2-1: Photograph of the Inside Slope of the North Ash Pond System Primary Cell Embankment

Figure 5.2.2-2: Photograph of the Inside Slope of the North Ash Pond System Secondary Cell Embankment

5.2.3 Downstream/Outside Slope and Toe

The outside slope of the embankment is vegetated with various species of tall grass and weeds. No major scarps, sloughs, bulging, cracks, depressions or other indications of slope instability, or signs of uncontrolled seepage were observed. Figure 5.2.3-1 shows a representative section of the outside slope of the embankment.

Figure 5.2.3-1: Photograph of the Outside Slope of the North Ash Pond System Embankment.

One large tree was observed near the emergency spillway of the North Ash Pond System. Figure 5.2.3-2 shows the tree.

Figure 5.2.3-2: Photograph of Large Tree Near Emergency Spillway on North Ash Pond System Embankment.

Most of the toe of the embankment is densely vegetated with various species of trees, grass, and weeds. In some sections, the toe is also armored with riprap. Figure 5.2.3-3 shows a portion of the toe that is armored with riprap and also covered in dense vegetation.

Figure 5.2.3-3: Photograph of Riprap and Dense Vegetation at the Toe of the North Ash Pond System Embankment.

5.2.4 Abutments and Groin Areas

The dike is continuous therefore there are no abutments. Descriptions of groin areas are included in the description of the dike crest and slopes.

5.3 NEW EAST ASH POND SYSTEM

5.3.1 Crest

The crest of the embankment had no signs of significant depressions, tension cracks or other indications of settlement or shear failure. Figure 5.3.1-1 shows the typical crest conditions.

Figure 5.3.1-1: Photograph of the Crest of the East Ash Pond System Embankment.

5.3.2 Upstream/Inside Slope

The inside slope of the East Ash Pond System embankment is vegetated with various species of tall grass and weeds. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability. Figure 5.3.2-1 shows a representative section of the inside slope of the primary cell embankment. Figure 5.3.2-2 shows a representative section of the inside slope of the secondary cell embankment.

Figure 5.3.2-1: Photograph of the Inside Slope of the East Ash Pond System Primary Cell Embankment.

Figure 5.3.2-2: Photograph of the Inside Slop of the East Ash Pond System Secondary Cell Embankment.

5.3.3 Downstream/Outside Slope and Toe

The outside slope of the embankment is vegetated with various species of tall grass and weeds. No major scarps, sloughs, bulging, cracks, depressions or other indications of slope instability, or signs of uncontrolled seepage were observed. Figure 5.3.3-1 shows a representative section of the outside slope of the embankment.

Figure 5.3.3-1: Photograph of the Outside Slope of the East Ash Pond System Embankment.

Most of the toe of the embankment is densely vegetated with various species of trees, grass, and weeds. In some sections, the toe is also armored with riprap. Figure 5.3.3-2 shows a portion of the toe that is armored with riprap and also covered in dense vegetation.

Figure 5.3.3-2: Photograph of Riprap and Vegetation at the Toe of the East Ash Pond System Embankment.

5.3.4 Abutments and Groin Areas

The dike is continuous therefore there are no abutments. Descriptions of groin areas are included in the description of the dike crest and slopes.

5.4 OUTLET STRUCTURES

5.4.1 Overflow Structure

The North Ash Pond System overflow structure discharges through a spillway into the Middle Fork Vermilon River, with a metal grate walkway for access. Adjacent to the riser is a depth gauge to show the water level.

The North Ash Pond System overflow structure was observed to be working properly, discharging flow from the pond, and visually appeared to be in satisfactory condition. There was no sign of clogging of the spillway and the water exiting the outlet was flowing clear. Figure 5.4.1-1 shows the main outlet structure.

Figure 5.4.1-1: Photograph of the North Ash Pond System Overflow Structure.

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The East Ash Pond System overflow structure also discharges through a spillway into the Middle Fork Vermilon River. There is a metal grate walkway over the concrete pipe for access.

The East Ash Pond System overflow structure was observed to be working properly, discharging flow from the pond, and visually appeared to be in satisfactory condition. There was no sign of clogging of the spillway and the water exiting the outlet was flowing clear. Figure 5.4.1-2 shows the main outlet structure.

Figure 5.4.1-2: Photograph of the East Ash Pond System Primary Outfall Structure.

An emergency outfall pipe is present in the East Ash Pond System, directly below the primary outfall structure. Figure 5.4.1-3 shows the emergency outfall pipe.

Figure 5.4.1-3: Photograph of the East Ash Pond System Emergency Outfall Pipe.

5.4.2 Outlet Conduit

The outlet conduit appeared to be in good shape and operating normally with no sign of clogging and the water exiting the outlet was flowing clear. Figure 5.4.2-1 shows the spillway outfall pipe discharge.

The design of the spillway outfall pipe includes a vertical bend upward at the discharge end. The upward bend provides energy dissipation that reduces potential erosion along the receiving drainageway.

5.4.3 Emergency Spillway

A corrugated metal pipe serves as the emergency spillway for the North Ash Pond System. The spillway has not been used in recent memory. Figure 5.4.3-1 shows the North Ash Pond System emergency spillway.

Figure 5.4.3-1: Photograph of the North Ash Pond System Emergency Spillway.

No emergency overflow spillway is present for the East Ash Pond System.

5.4.4 Low Level Outlet

No low level outlet is present.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

No documentation has been provided about the flood of record.

6.1.2 Inflow Design Flood

URS, the design firm for the East Ash Pond System expansion, conducted a hydrologic and hydraulic analysis of the capacity of the East Ash Pond System to store water from the design storm event (See Appendix A – Doc. 16). Per State requirements, the design storm is a 100-year (1 percent probability in a given year) event. The report estimates that the 1 percent probability storm will raise the level of the pond 0.8 tenths of a foot, leaving a freeboard of 2 feet.

6.1.3 Spillway Rating

The URS hydrologic/hydraulic analysis for the East Ash Pond System (Appendix A – Doc 16) reports that the combined discharge from building and coal pile runoff is 4.5 cfs. The spillway was designed with a 400 cfs capacity to allow for future expansion.

6.1.4 Downstream Flood Analysis

The hydrologic/hydraulic analysis for the East Ash Pond System notes that the expansion raised the 100-year event water surface level of the Middle Fork Vermilion River by 3 inches. The report notes that IDNR deemed this increase in water surface level minimal (Appendix A—Doc 16).

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting documentation for the East Ash Pond System is adequate.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Based on the calculations provided in the hydrologic and hydraulic study (Appendix A – Doc 16) the East Ash Pond System can retain the 1 percent design storm event with a freeboard safety of 2 feet. Hence dike failure by overtopping seems improbable.

7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

East Ash Pond System

The Dynegy Calculation Book (Appendix A – Doc 16) includes two sets of slope stability analyses: "East Ash Pond Expansion Slope Stability Analyses by URS" dated April 30, 2002, and "East Ash Pond Expansion – Final Report – Slope Stability Analysis by URS" dated July 9, 2002.

Both reports analyzed the same five load conditions.

- Downstream slope with pond full – gravity loads only
- Upstream slope with pond full – gravity loads only
- Downstream slope with pond full – seismic and gravity loads
- Upstream slope with pond full – seismic and gravity loads
- Upstream slope after 20 ft. rapid drawdown – gravity loads only.

Based on the results of the analyses it was concluded that the embankment has stability safety factors at or above the minimum recommended values.

7.1.2 Design Parameters and Dam Materials

East Ash Pond System

The Dynegy Calculation Book (Appendix A – Doc 16) includes the results of two sets of slope stability analyses performed by URS Corp. The first set, dated April 30, 2002, used soil properties based on data provided by others and adjusted based on published literature. The report, dated July 9, 2002, presents the results of soil shear strength tests and discusses minor changes in dike design. The report indicates the changes were analyzed and the previously calculated safety factors were not significantly affected. The July 2002 report concludes that the preliminary slope stability analyses should be considered final.

The documentation provided indicates the preliminary stability analyses assumed nine geologic strata: existing dike – sandy gravelly clay; new dike sandy- gravelly clay; native glacial till; upper 5 feet of alluvium; bottom 5 feet of alluvium; sand and gravel fill; weak shale, shale and bottom ash. The material properties used for the stability analyses are shown in Table 7.2.1

Table 7.2.1 Summary of Soil Properties Used in Stability Analyses

Soil Strata	Unit Weight (pounds/cubic foot)	Drained Shear Strength Properties	
		Cohesive Strength (pounds/square foot)	Angle of Internal Friction
Existing Dike	137	1,480	25.1
New	137	1,480	25.1
Native Glacial Till	137	0	30
Alluvium - Top 5 ft.	120	0	28
Alluvium - Bottom 5 ft.	120	0	30
Sand & Gravel Fill	130	0	36
Weak Shale	140	400	18
Shale	140	1,000	35
Bottom Ash	97	0	30

The April 2002 report, which is the basis for the reported slope safety factors states that the slope stability analyses were conducted using long-term, drained soil strength parameters as a more realistic approach to ensuring the long term stability of the slope. The report also indicates that short-term stability was not analyzed because it will not control stability (see Section 7.3).

Slope stability analysis data sheets indicate the embankment was modeled as consisting of clayey fill in the upstream half of the cross section and sand and gravel fill in the downstream half of the cross section. Construction drawings (Appendix A Doc 07 – 09) indicate the embankment consists of a clay core surrounded by compacted clayey and gravelly sands.

7.1.3 Uplift and/or Phreatic Surface Assumptions

East Ash Pond System

The URS Slope Stability reports included in the Calculation Book (Appendix A – Doc 16) indicate that two separate piezometric surfaces were used in the analyses. The first piezometric surface was used for all soils except the bottom ash. It assumes an upstream phreatic surface equal to the normal pool elevation, with the elevation decreasing as it passes through the upstream half of the embankment cross section. At the center of the embankment cross section an internal drain lowers the phreatic surface to an elevation equal to the top of the original dike.

The piezometric surface in the bottom ash was modeled based on full hydrostatic pressure with the pond at normal pool elevation. The model was selected to account for hydrostatic uplift forces at the base of the embankment.

7.1.4 Factors of Safety and Base Stresses

East Ash Pond System

The URS slope stability reports (Appendix A – Doc 16) indicate stability analyses were conducted for two cross-sections shown in prior calculations by others to be the critical locations. The two locations, designated Critical Section 1 and Critical Section 2 are located in the southeast portion of the pond, and the north section of the pond between the primary and secondary ponds, respectively. The safety factors reported in the slope stability report are listed in Table 7.1.4

Table 7.1.4 Slope Stability Factor of Safety Vermilion East Ash Pond

Loading Condition	Required Safety Factor (US Army Corps of Engineers)	Critical Section 1	Critical Section 2
Downstream slope – Pond Full – Gravity Only	1.5	1.9	1.5
Upstream slope – Pond Full – Gravity Only	1.5	2.1	1.5
Downstream slope – Pond Full – Seismic and Gravity	>1.0	1.8	1.4
Upstream slope – Pond Full – Seismic and Gravity	>1.0	1.8	1.2
Upstream Slope after 20 ft. rapid Drawdown – Gravity Only	1.3	1.3	1.3

Based on the results summarized in Table 7.1.4 the embankments were found to have stability safety factors at or above the recommended minimum values.

7.1.5 Liquefaction Potential

East Ash Pond System

The URS Stability Analysis reports reviewed by Dewberry (Appendix A – Doc 16) indicated that an evaluation of the liquefaction potential of subsurface materials was not conducted. The documentation indicates that based on the clay and medium dense sands present at the site, a liquefaction analysis was not required.

7.1.6 Critical Geological Conditions

East Ash Pond System

Unconsolidated geologic deposits at the site consist of alluvial and colluvial deposits underlain by glacial till. Beneath the glacial till is weathered shale and shale bedrock.

The stability analyses (Appendix A – Doc 16) used a peak ground acceleration of 0.025g for seismic loading.

The current Seismic Risk Map of the United States was reviewed using the U. S. Geologic Survey web site. The 2% probability of exceedance in 50 years ground acceleration at the site is 0.19g to 0.26g. The seismic design criteria used in the analysis is in conformance with current design recommendations.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

East Ash Pond

Structural stability documentation is adequate.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Overall, the structural stability of the East Ash Pond System embankment appears to be satisfactory based on the following observations:

- No obvious signs of erosion damage, cracks, sloughs or release of materials;
- Outlet works are in good working condition;
- Embankment is regulated by the State of Illinois and therefore is subject to periodic inspections by State dam safety officials;
- Existence of a State-approved Operations and Maintenance manual;
- Existence of recent inspection reports;

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

The East Ash Pond System is operated for storage of fly ash deposits. Treated coal combustion process waste water is discharged through an overflow outlet structure.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

The East Ash Pond System Operations and Maintenance Plan (Appendix A – Doc 20) establishes inspection and maintenance requirements for the embankment. The required procedures include:

- Quarterly inspections by plant personnel
- Annual inspections by a licensed professional engineer in accordance with IDNR requirements
- Maintenance of low-growth vegetation cover, including tree and shrub removal
- Semiannual inspections of the effluent discharge canal
- Repair of animal burrows
- Reporting requirements

The Operations and Maintenance Plan also includes the quarterly inspection form.

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

8.3.1 Adequacy of Operating Procedures

Based on the assessments of this report, operation procedures seem to be adequate.

8.3.2 Adequacy of Maintenance

Various dam inspection reports, including P.E. inspection reports dated February 13, 2009 and March 30, 2010 (Appendix A – Docs 21 and 22) and the Dam Inspection Checklist of August 10, 2010 by Dewberry (Appendix C), reported no major maintenance issues. The 2009 and 2010 P.E. Inspection Reports include some maintenance recommendations, but none that are considered critical or imminent. This indicates that the current maintenance plan is most likely followed in practice, and that adequate maintenance is provided for the embankments and project facilities.

Although maintenance appears to be adequate, the following recommendations were made in the 2009 and 2010 inspection reports:

- Monitor and eliminate saplings along embankment
- Limit traffic on embankments to decrease cracking along slope face

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Weekly Inspections

Weekly inspections are conducted by plant personnel.

Quarterly Inspections

Quarterly Inspections are conducted by qualified plant personnel.

Annual Inspections

Annual inspections are conducted by a licensed professional engineer (employed by URS) in accordance with IDNR regulations. The 2010 Inspection Report was submitted in March of 2010.

Special Inspections

No special inspections have been conducted at the Vermilion Power Station fly ash ponds.

9.2 INSTRUMENTATION MONITORING

The Vermilion Power Station embankments do not have an instrumentation monitoring system.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Based on the data reviewed by Dewberry, including observations during the site visit, the inspection program is adequate.

9.3.2 Adequacy of Instrumentation Monitoring Program

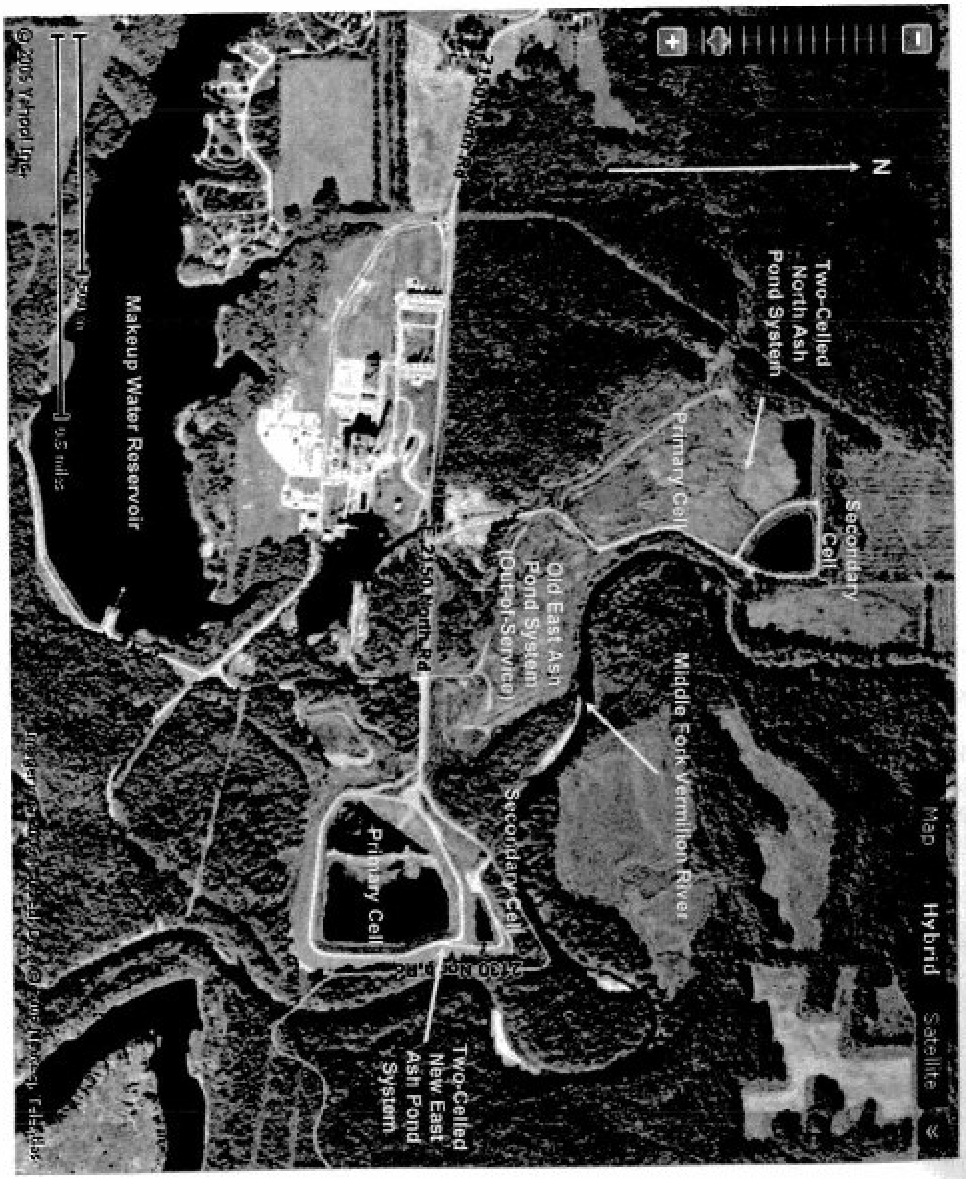
The Vermilion Power Station embankments are not instrumented. Based on the size of the embankments, the portion of the impoundment currently used to store wet fly ash and stormwater, the history of satisfactory impoundment performance, and the current inspection program, installation of a dike monitoring system is not needed at this time.

APPENDIX A

Documents

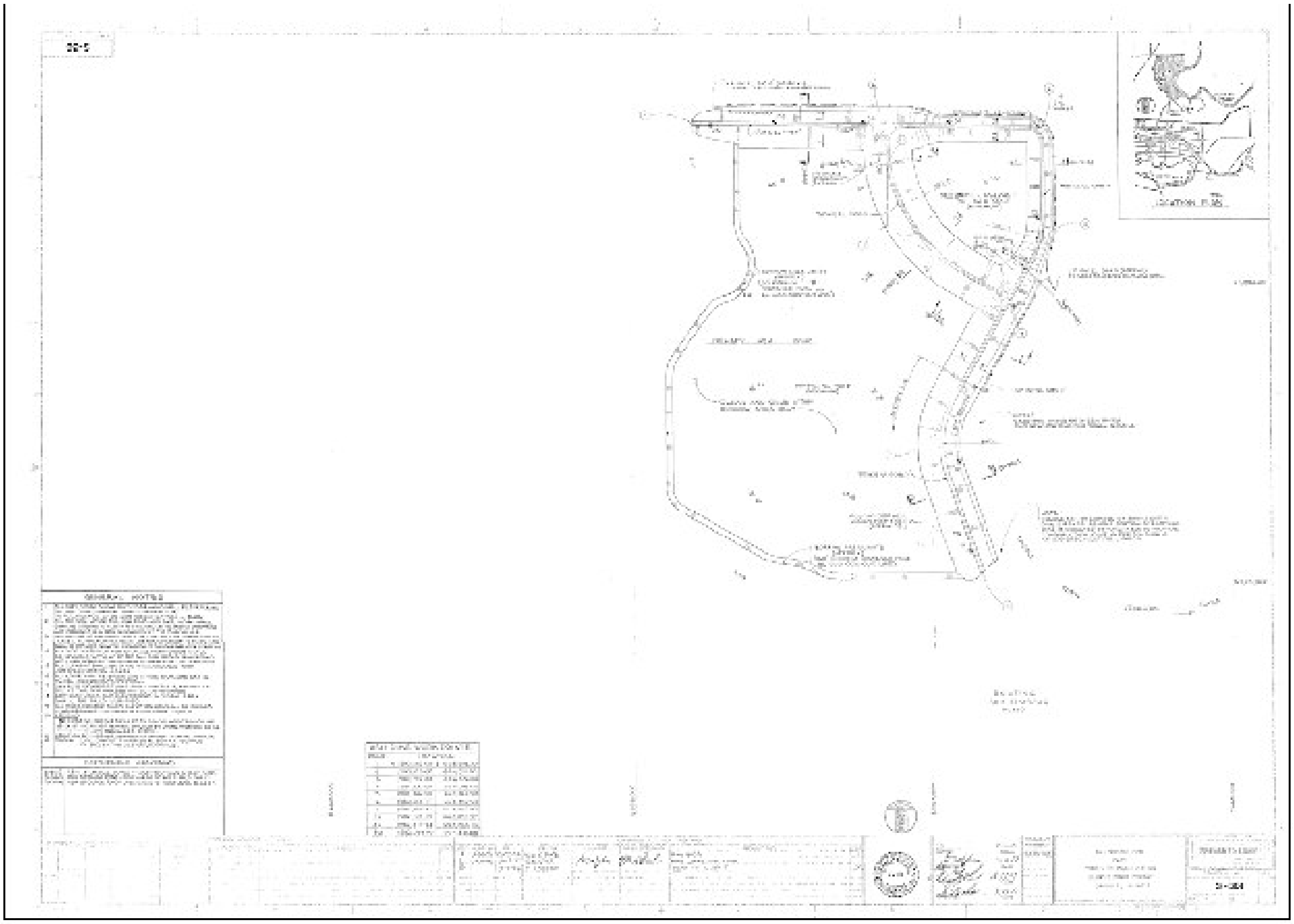
Document 1: Map of site

Document 2: Labeled Aerial Photo

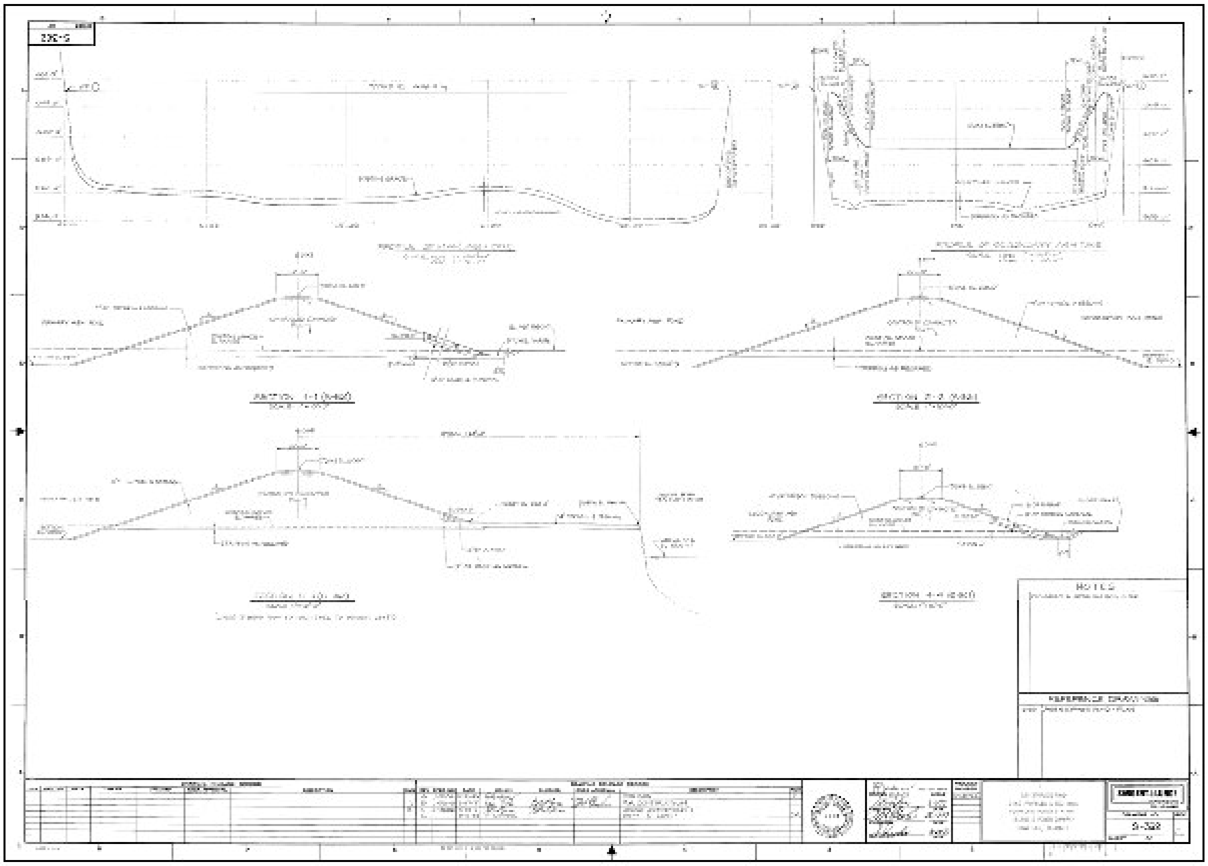


Vermillion Power Station Ash Pond Systems

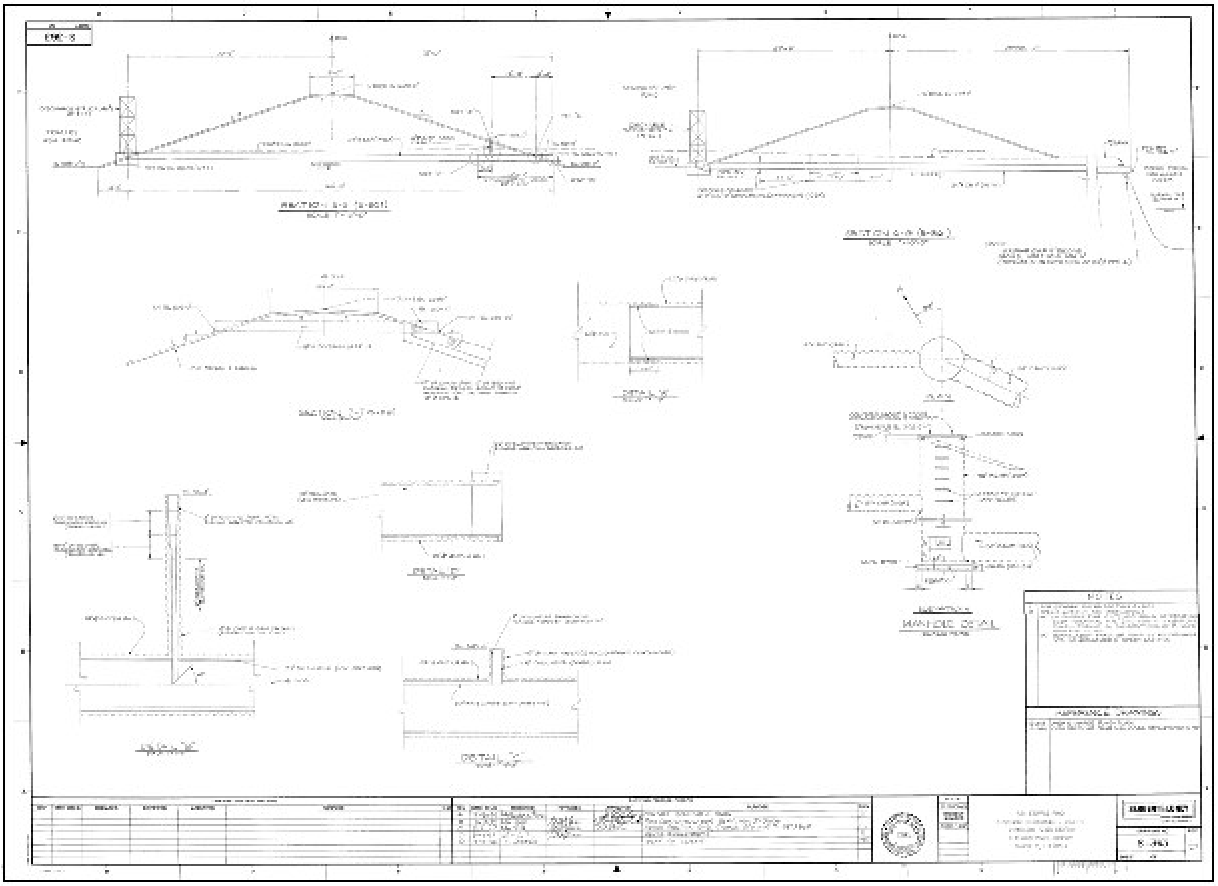
Document 3: North Ash Pond System Plan Drawing



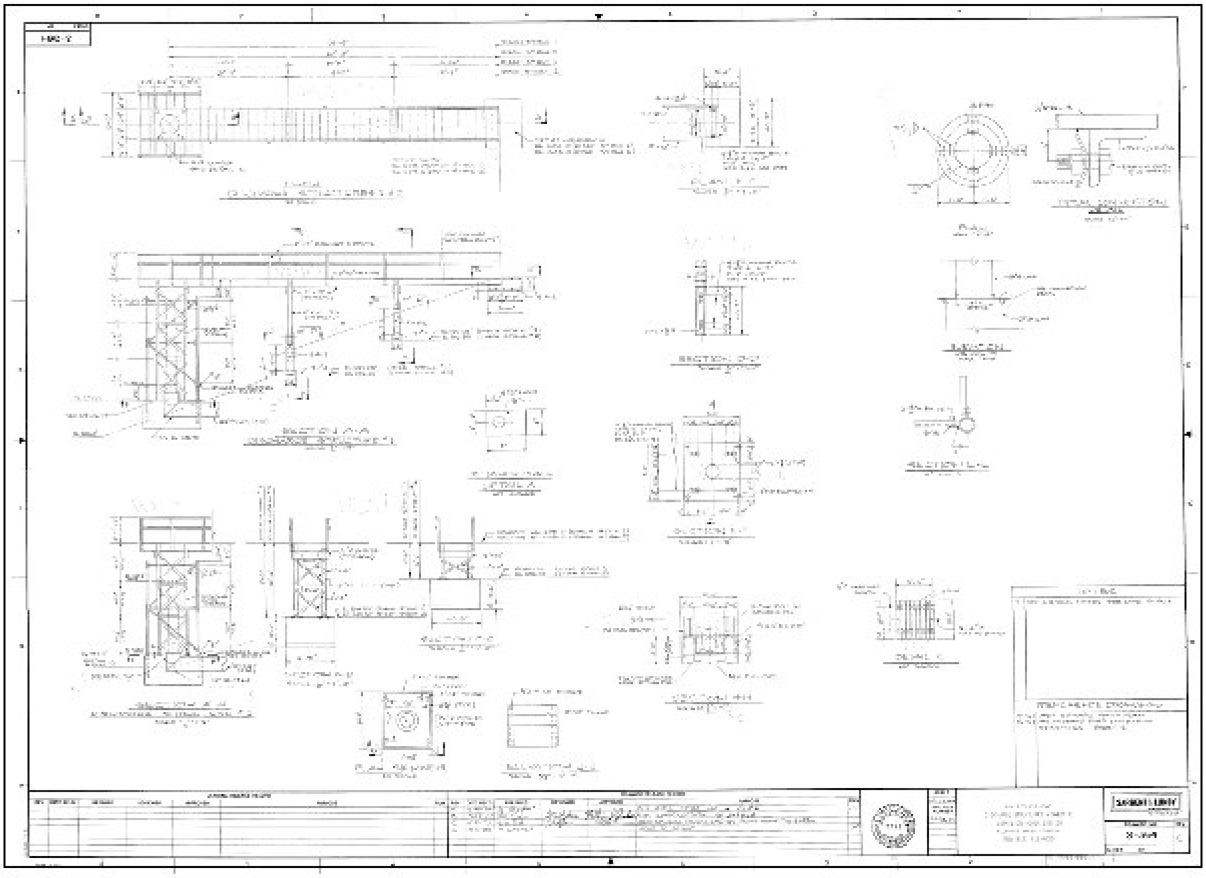
Document 4: North Ash Pond System Typical Sections



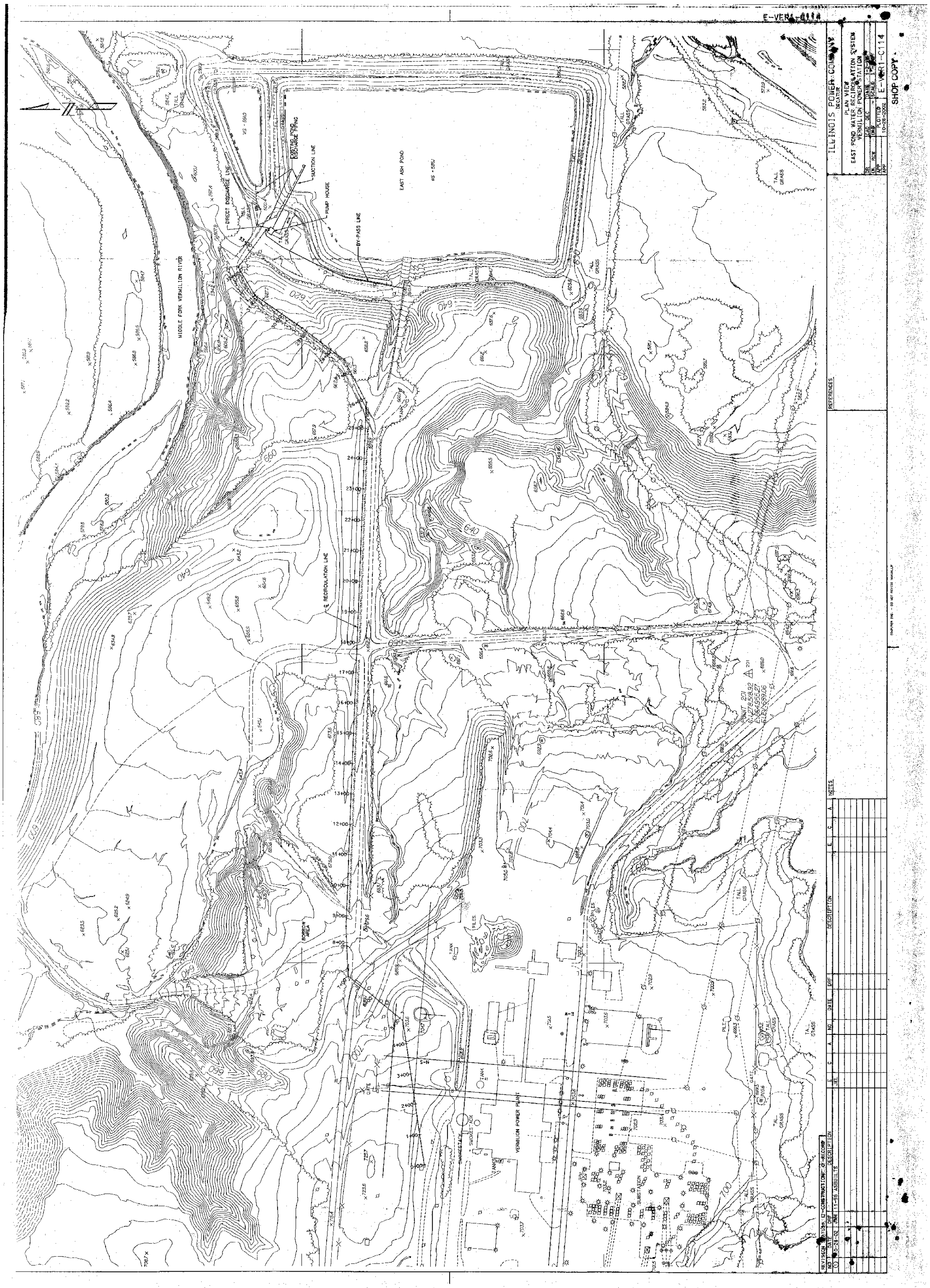
Document 5: North Ash Pond System Discharge Structure Details



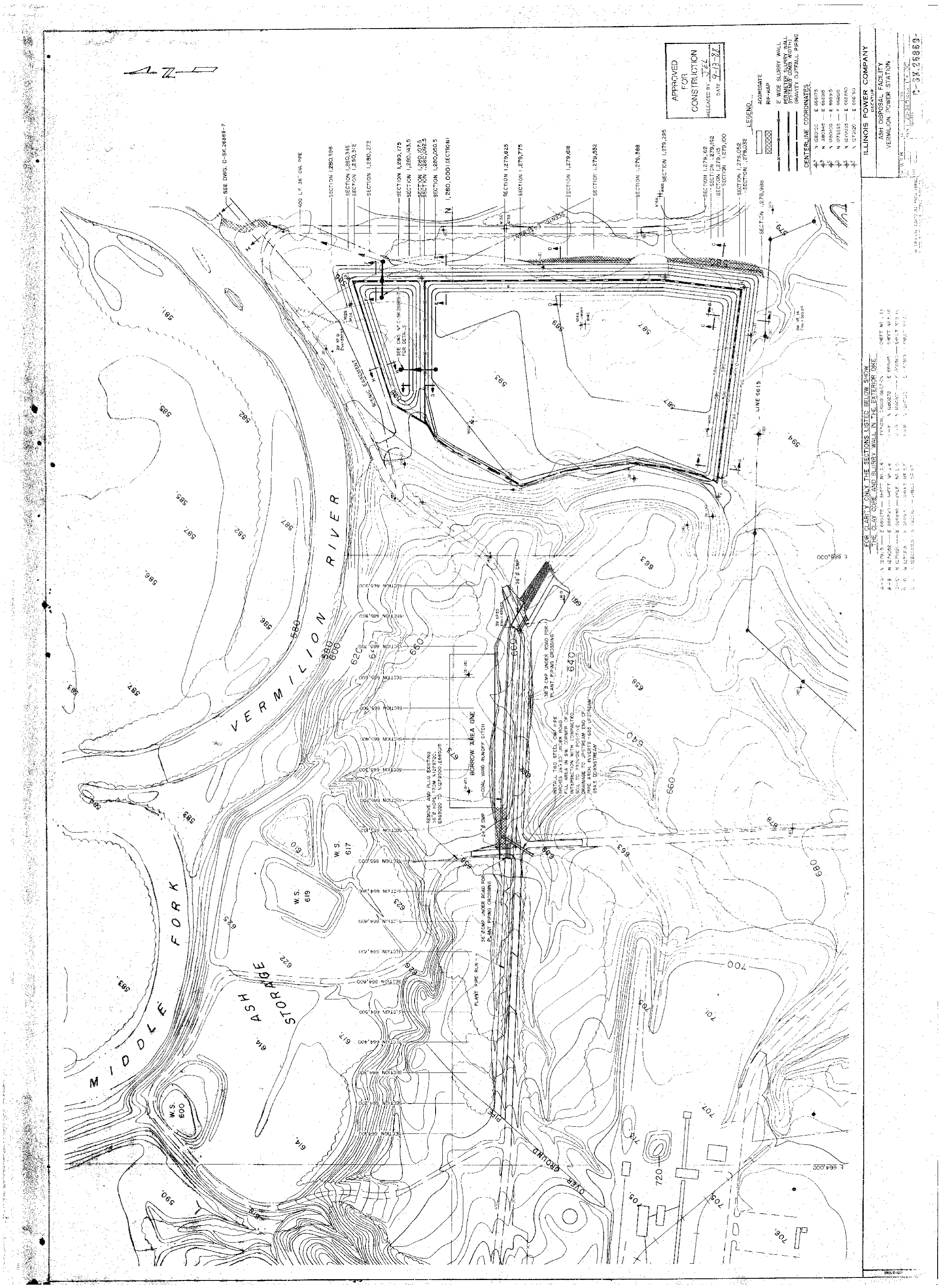
Document 6: North Ash Pond System Discharge Structure Additional Details



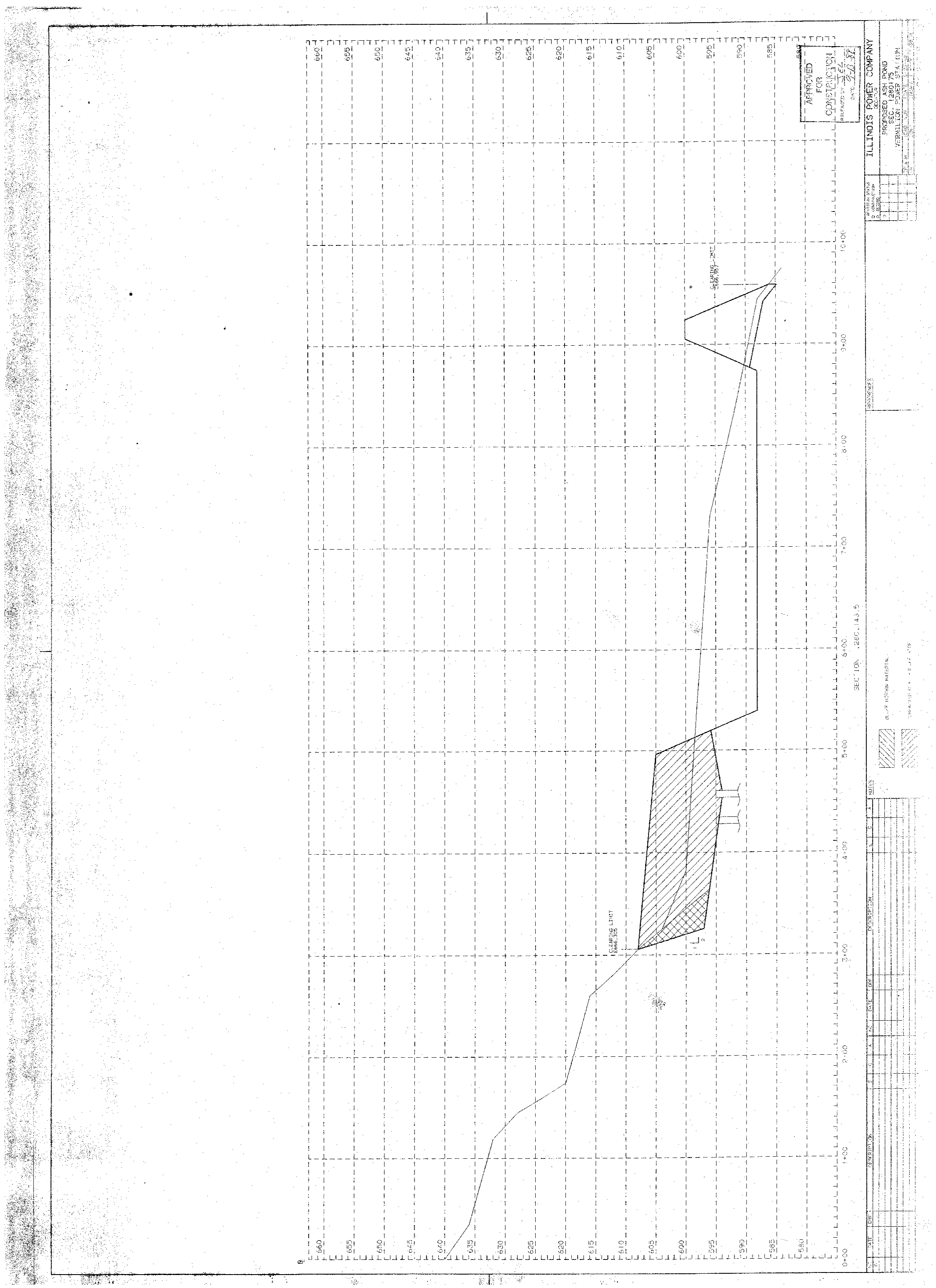
Document 7: East Ash Pond System Plan View



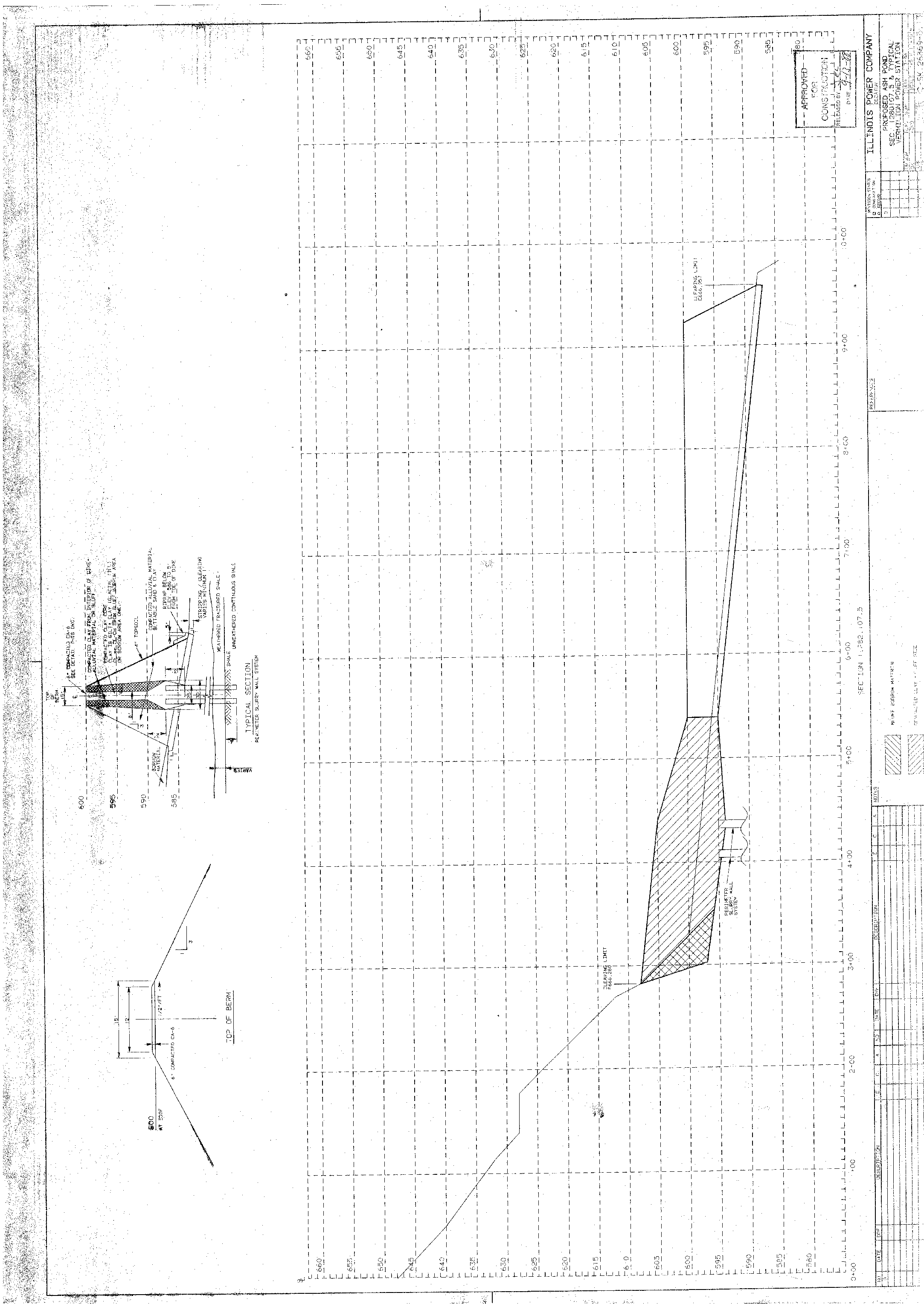
Document 8: East Ash Pond System Plan Layout with Cross-Section Locations



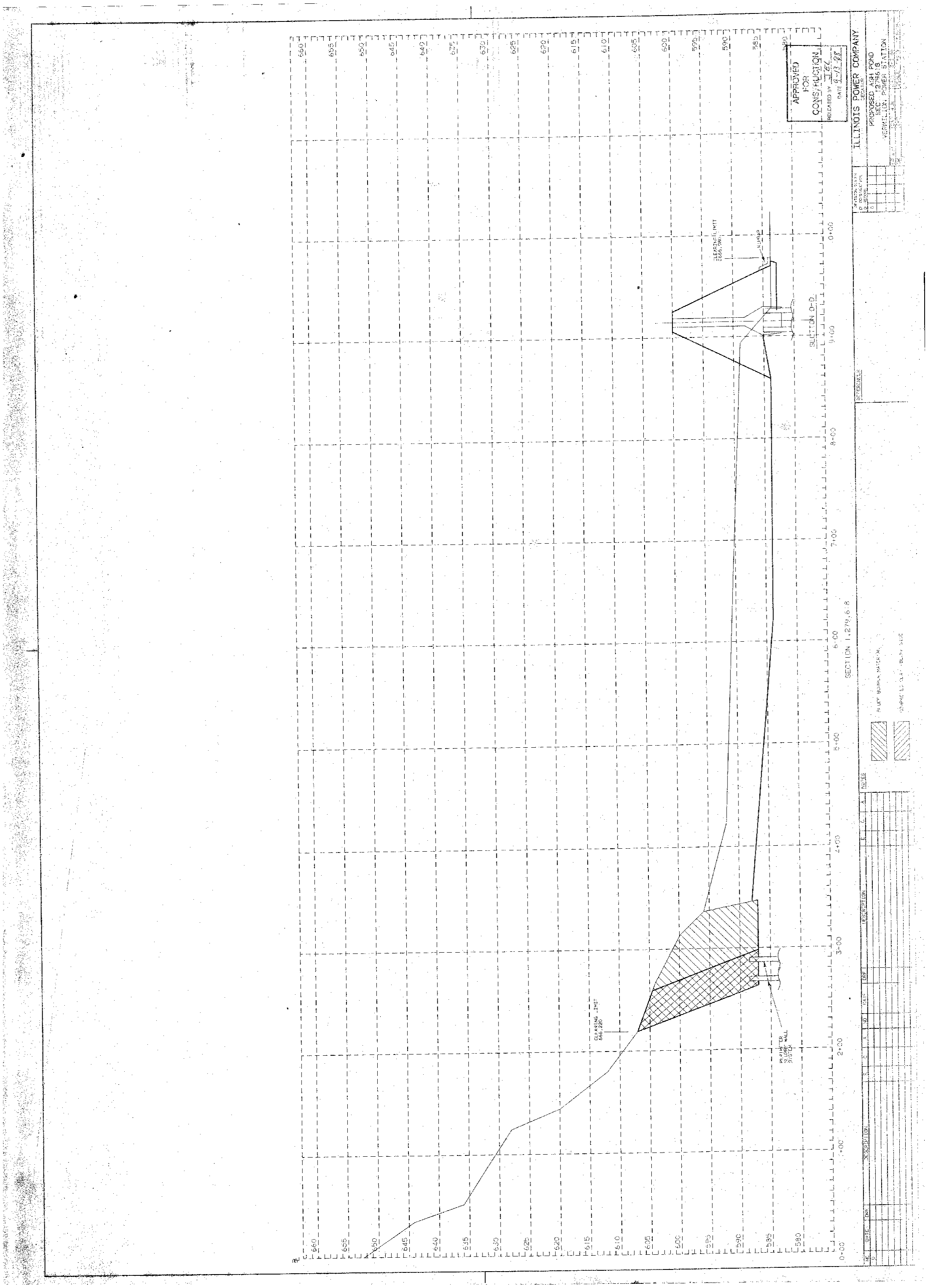
Document 9: East Ash Pond System Typical Sections 1 of 3



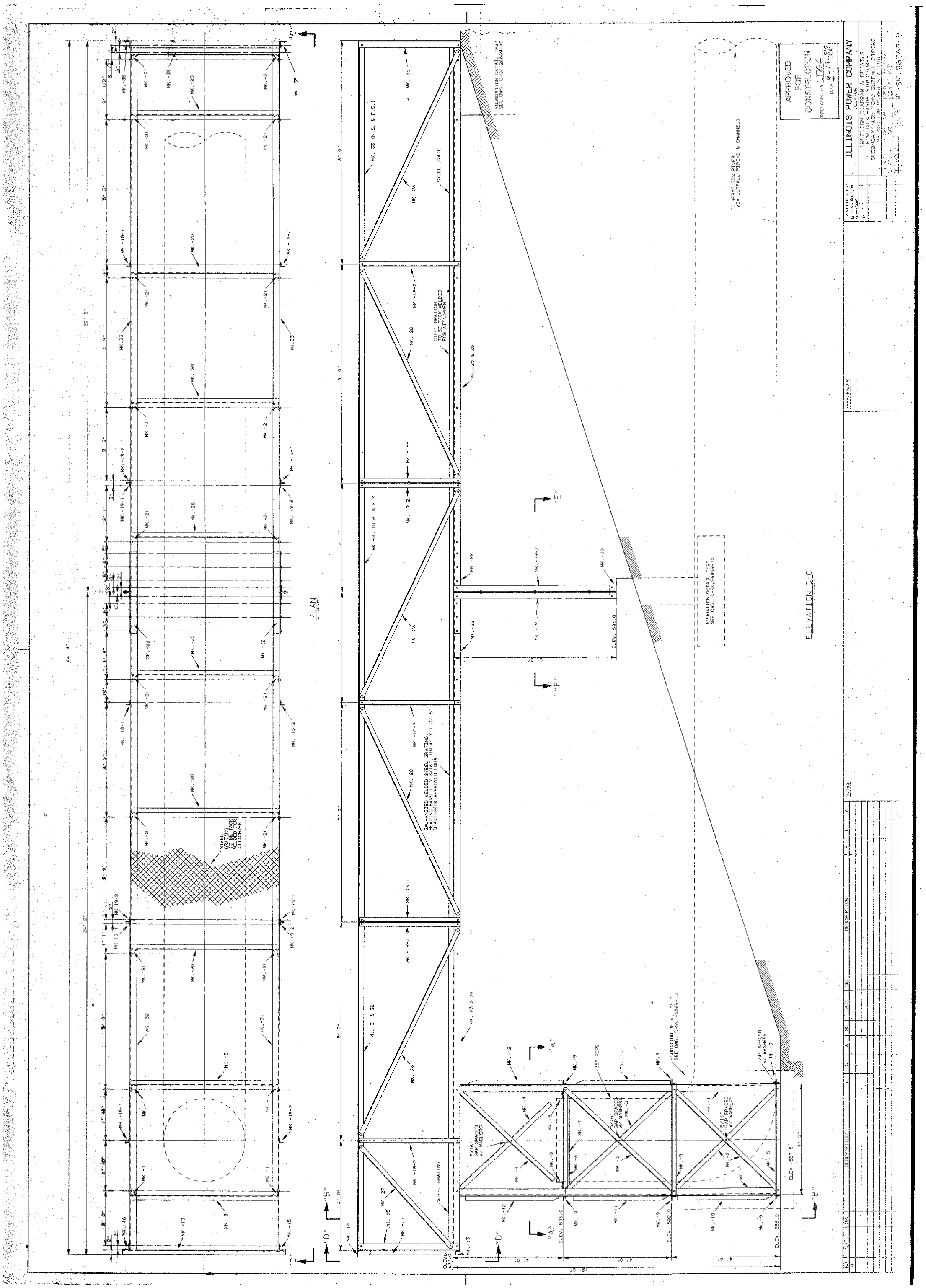
Document 10: East Ash Pond System Typical Sections 2 of 3



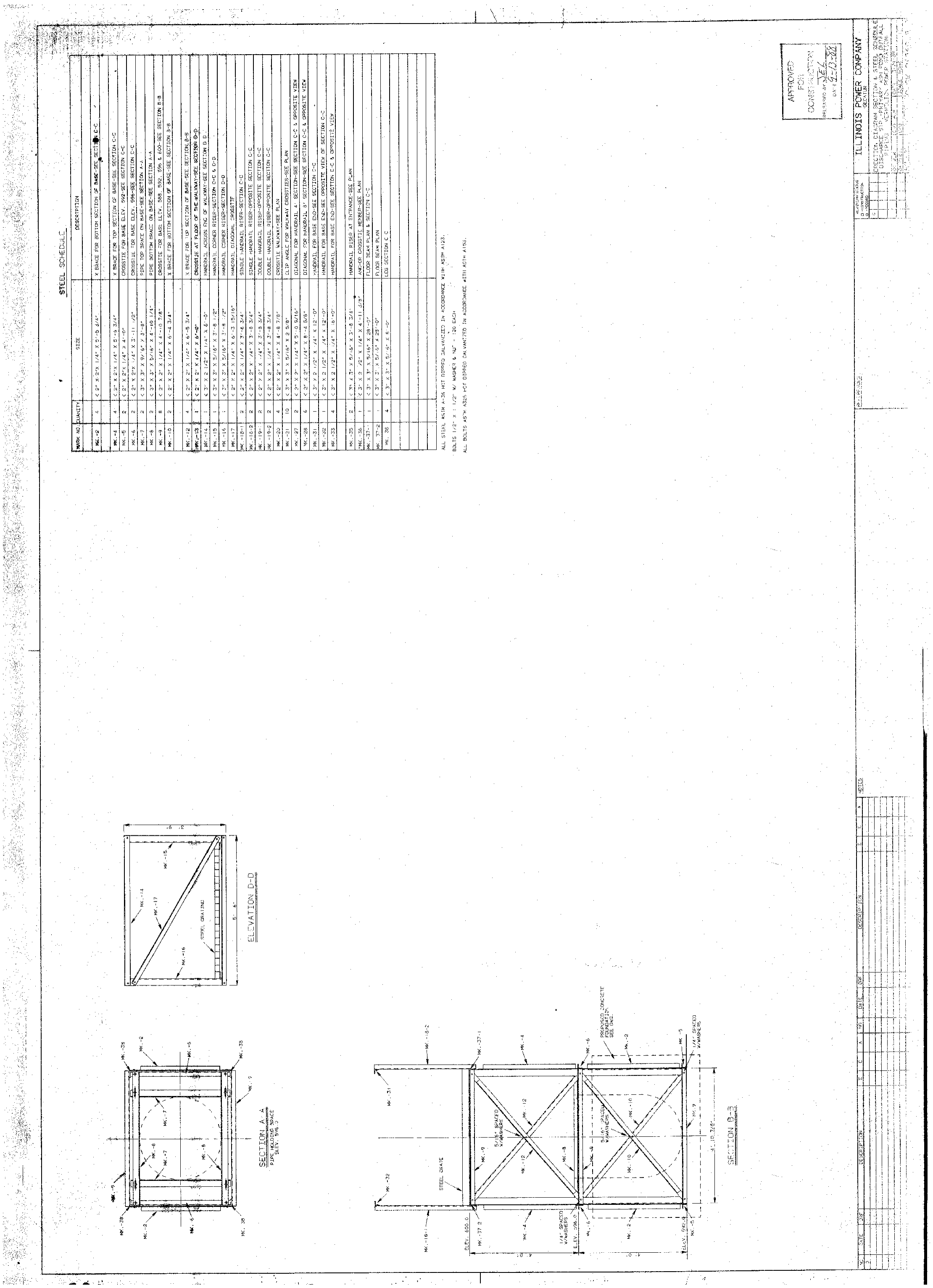
Document 11: East Ash Pond System Typical Sections 3 of 3



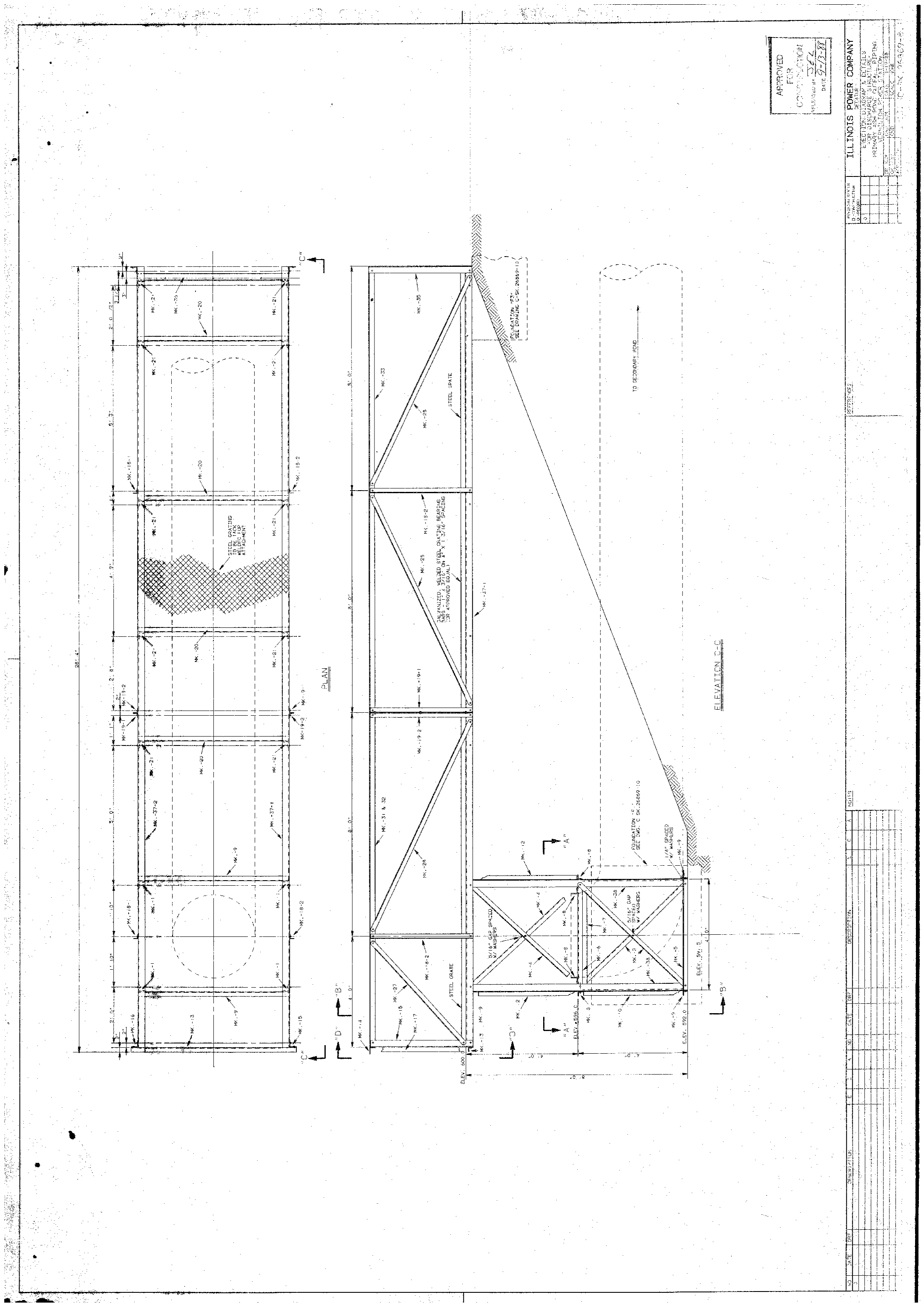
Document 12: East Ash Pond System Discharge Structure Details 1 of 3



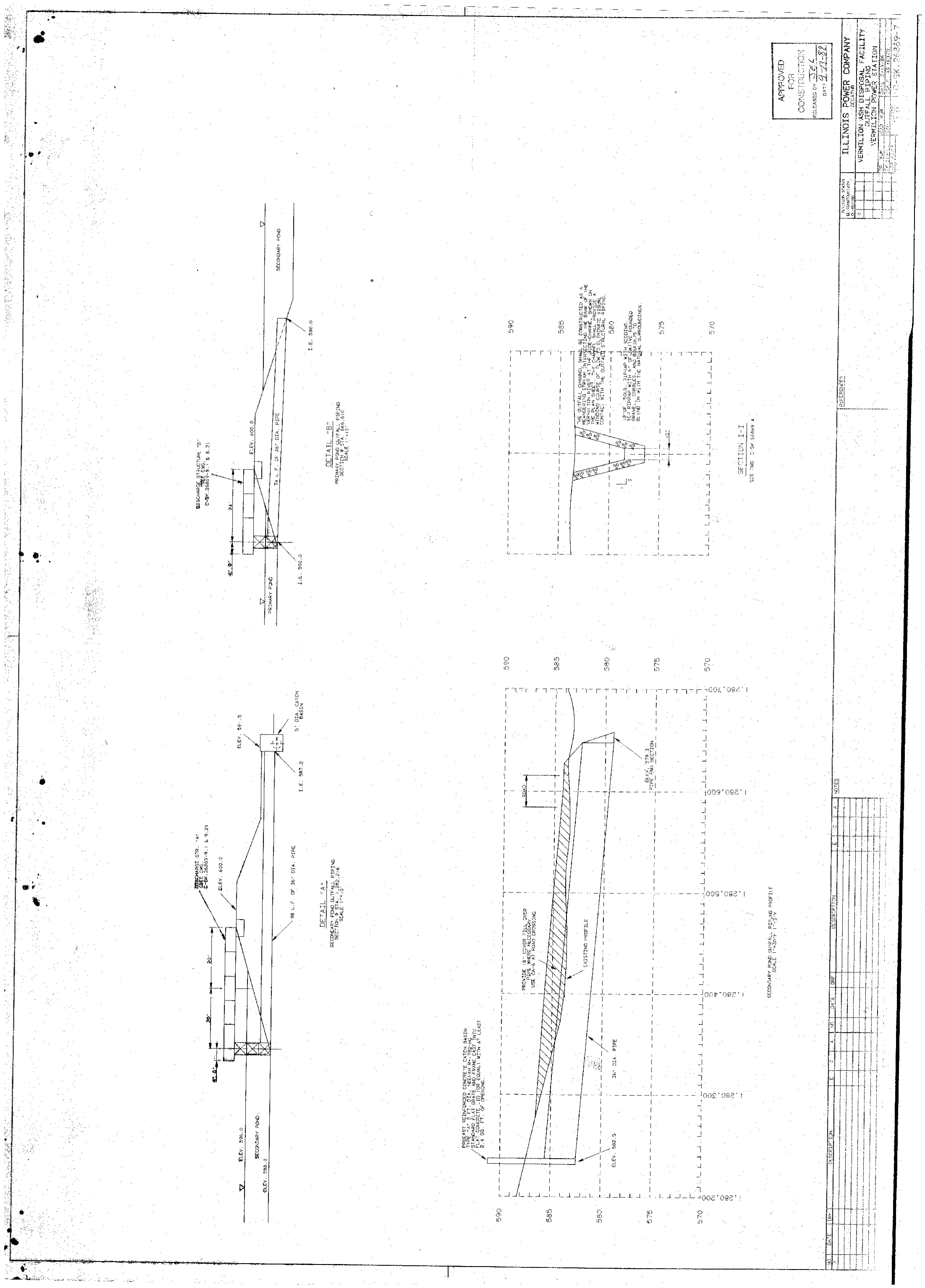
Document 13: East Ash Pond System Discharge Structure Details 2 of 3



Document 14: East Ash Pond System Discharge Structure Details 3 of 3



Document 15: East Ash Pond System Outfall Piping



Document 16

Dynegy Midwest Generation

Vermilion Power Station

Danville Illinois

Expansion of Existing Ash Pond

23-20020051.00

07/01/02

Calculation Book

INDEPENDENT TECHNICAL REVIEW REPORT

I. Project and Document Information

(To be completed by the Project Manager)

Client: Dynegy Project Number: 23-20020051.00

Project Name: East Ash Pond Expansion - Vermilion Power Station

Assigned Independent Reviewer: Jim Scott

Document to be Reviewed: Plans and Specifications

(Title/Revision Number)

The review scope (continued on the attachment): Plans & Specifications

Submitted by:

Project Manager Date Author Date

II. Review Summary:

(To be completed by the Independent Reviewer)

I have reviewed the above-referenced document in accordance with the appropriate checklist(s) and project scope. My conclusions are as follows:

- Plans - comments provided on work product and reviewed with Don Grahlherr
- Specifications - comments provided on work product and reviewed with D. Grahlherr, R. Bird, and B. Durbin.

Reference comments on: ☒ Work product or ☐ Exhibit 2.2-4, pages ____ through ____

III. Reviewer Report:

A. ☒ The Reviewer's comments have been provided.

JCS

Reviewer's Initials Date 6/12/02

(To be completed by the Independent Technical Reviewer; Approved by the Project Manager or Principal-in-Charge, if and when comments are provided.)

B. ☒ Verification of correct incorporation of resolved comments into final document is complete

(To be completed after verification of comment incorporation OR if there are no comments)

Submitted by: Jim Scott Date 6/12/02

Independent Technical Reviewer 7/15/02

C. ☒ This review has been completed. Any significant issues not resolved between the Independent Technical Reviewer and the Originator have been resolved by me. (To be signed after A and B are completed)

Approved by: William L Durbin Date 7/15/02

Project Manager or Principal-in-Charge or designee (as applicable)

Note: If there is a dispute between the author and reviewer, the Project Manager and if needed, the Principal-in-Charge is consulted.

cc: Project Quality Assurance File

Table of Contents

URS **EXHIBIT 4.7-2**

CALCULATION COVER SHEET

Client: Dynegy (Joe Kimlinger) Project Name: DYNEGY VERMILION

Project/Calculation Number: 23-20020051.00

Title: Slope Stability Calculations

Prepared by: Doug Hardin Date: 6/28/02

Checked by: SEE CALCULATION SHEET FOR CKD BY Date: 6/28/02

[redacted]

Description and Purpose:*

Design Basis/References/Assumptions*

Remarks/Conclusions/Results:*

Calculation Approved by: ____________________

Project Manager/Date

Revision No.:	Description of Revision:	Prepared By/ Date	Checked By/ Date	Project Mgr./ Date
1				
2				
3				

*(attachments okay)

Dynegy – Vermilion Plant
East Ash Pond Expansion
Slope Stability Analysis by URS

1.0 Introduction

URS has revised the slope stability analyses done by Illinois Power as described in the March 20, 2002 report by D.M. Gaskins as requested by OWR and to conform with typical procedures used by URS. The key differences in the revised analyses are summarized in the following section. The URS analysis is then described in detail.

2.0 Differences between Illinois Power and URS Slope Stability Analysis

Slope stability analyses were performed to confirm that the stability of the dike raise for the East Ash Pond Expansion at the Vermilion Plant is satisfactory. Our stability analysis generally followed along similar lines as Illinois Power's reported by D.M. Gaskins on March 20, 2002. Important exceptions to this statement are highlighted in this section below. For a detailed explanation of the URS approach to the slope stability analysis, see section 3.0 below.

There are several major differences between the Illinois Power and URS analysis. These differences are as follows:

- URS analyzed the two critical embankments and load cases analyzed by Illinois Power. Critical section 2 was modified slightly to eliminate the 1H: 1V slope on the upstream side of the dike because this slope will be unstable over the long term.

- The piezometric surface used by the Slope/W program was modeled somewhat differently in locations by URS and Illinois Power. This is particularly true for the bottom ash. Due to its high permeability, the full water pressure from the pond is expected to be present throughout the bottom ash even under the more clayey dike materials. Because of this, URS modeled the bottom ash piezometric surface to account for hydrostatic uplift forces on the base of failure slices through the bottom ash.

- URS used more realistic long-term, drained soil strength properties based on available correlations and the U.S. Bureau of Reclamation (USBR) recommendations for compacted soils in small dams.

- URS used a more realistic seismic coefficient of 0.025g for its psuedo-static seismic stability analysis based on U.S. Army Corps of Engineers (USACE) guidelines.

3.0 URS Stability Analyses

Preliminary slope stability analyses were performed to confirm that the stability of the dike raise for the East Ash Pond Expansion at the Vermilion Plant is satisfactory. The critical dike sections used for the analysis are discussed below. Slopes were analyzed using assumed long-term, drained soil properties to ensure the long-term stability of the slopes. The drained soil properties were assumed based on the information available at the time of the analysis. Short-term stability using undrained soil properties was not analyzed because it will not control stability. The following load cases were analyzed for each critical section:

- Downstream slope with pond full of water – gravity loads only
- Upstream slope with pond full of water – gravity loads only
- Downstream slope with pond full of water – seismic and gravity loads
- Upstream slope with pond full of water – seismic and gravity loads
- Upstream slope after 20 ft rapid drawdown of the pond – gravity loads only

Slope stability was analyzed using the computer program "Slope/W" from Geo-Slope International. Slope/W uses limit equilibrium theory to compute the factor of safety of earth and rock slopes. The factors of safety reported are the lowest obtained for searches using the Spencer Method on circular and wedge shaped failure surfaces. Wedge shaped failure surfaces resulted in factors of safety greater than those for circular failure surfaces and are therefore not reported. Adequate factors of safety were taken as 1.5 for gravity loads only, 1.0 for seismic and gravity loads, and 1.2 for a rapid drawdown condition per U.S. Army Corps of Engineers (USACE) guidelines.

3.1 Dike Section Modeling

Two critical dike sections were chosen for analysis based on the available plans for the East Ash Pond Expansion prepared by Illinois Power, available boring logs in the area, and a contour map showing the expected elevation of shale in the area of the pond. Critical section 1 is located to the southeast of the pond and is labeled as "Typical Section No 1" in the plans. Critical section 2 is located to the north of the pond between the primary and secondary ponds and is labeled as "Typical Section No 5" in the plans. Available boring logs were used to extend the soil profile of the critical dike sections down to shale. Critical section 2 was modified from the plan "typical section" to eliminate the 1H: 1V slope on the upstream side of the dike because this slope will be unstable over the long term.

The water level in the primary pond was modeled at 2 ft (Elev. 618) below the crest of the dike for all cases but the rapid drawdown condition. The water level in the secondary pond for critical section 2 was modeled at Elev. 593 which is near the normal operating level for that pond based on available information. The piezometric surface through the dike was modeled as is typically done based on the permeability of the dike materials.

Two separate piezometric surfaces were used while modeling critical section 2. The first piezometric surface was for all dike soils except for the bottom ash. The second piezometric surface was for the bottom ash. Due to its high permeability, the full water pressure from the pond is expected to be present throughout the bottom ash even under the more clayey dike materials. The bottom ash piezometric surface was modeled in this manner to account for hydrostatic uplift forces on the base of failure slices through the bottom ash. A rapid drawdown of 20 ft was modeled in accordance with the drawdown plan for the East Ash Pond Expansion.

A seismic coefficient of 0.025g was used in pseudo-static stability analysis to check the seismic stability of the critical dike sections. This coefficient was chosen based on USACE guidelines. No check was done for liquefaction of subsurface materials due to the small seismic coefficient and nature of the foundation and dike materials (clay or medium dense silty sand).

3.2 Soil Properties

As discussed above, assumed long-term, drained soil properties were used for the stability analysis. Several correlations were made to determine drained soil properties for the dike and underlying natural soil materials based on judgement, available soil index properties, and soil descriptions in available boring logs. The properties chosen and used in the analysis are outlined in the attached Table 1.

We understand that OWR recommended that the drained analysis be done assuming no cohesion for the compacted embankment soils which will generally be low plastic clay (CL). We generally agree with this approach, but typically use a small cohesion value, about 100 to 200 psf. This small cohesion is used for practical purposes to model the failure surface, which is non-linear with a zero intercept, and to prevent spurious failure surfaces that are not realistic. Because of OWR's request that zero cohesion be used, we adopted a bilinear failure surface for the embankment fill with a zero cohesion intercept. This bilinear surface is a simple way to model the actual failure surface which is most likely non-linear as noted by Mesri (1993). Mesri's paper is attached for information.

The bilinear strength envelope used is shown as part of Table 1 along with U.S. Bureau of Reclamation (USBR) design envelopes for CL and ML type materials. The USBR envelopes shown are for average data shown in the 3rd edition of their "Design of Small Dams". As is shown, the URS design envelope is reasonably conservative compared to the USBR envelopes. Natural soils were modeled using zero cohesion. A 2-ft thick layer of weak shale was assumed used on top of more competent shale to analyze the factor of safety of a possible wedge failure along the shale bedrock.

Soil properties used in the analysis were assumed based on the information available and should be considered preliminary. The stability of the dike raise will be reanalyzed as needed after site-specific soil properties have been determined using laboratory testing.

The planned testing includes consolidated-undrained triaxial tests with pore pressure measurements to obtain the drained soil properties.

3.3 Results

Results of the stability analysis are summarized in the table below. All slopes analyzed had factors of safety at or above the minimum required per USACE guidelines. The graphical computer output and general notes for each stability case analyzed are located in the attached calculation sheets dated April 29, 2002.

Summary of Results for Slope Stability Analysis		
		Factor of Safety
Critical Section 1		
Case	1A: downstream slope, full pond, gravity loads only	1.9
	1B: upstream slope, full pond, gravity loads only	2.1
	2A: downstream slope, full pond, seismic and gravity loads	1.8
	2B: upstream slope, full pond, seismic and gravity loads	1.8
	3: upstream slope, 20 ft rapid drawdown, gravity loads only	1.3
Critical Section 2		
Case	1A: downstream slope, full pond, gravity loads only	1.5
	1B: upstream slope, full pond, gravity loads only	1.5
	2A: downstream slope, full pond, seismic and gravity loads	1.4
	2B: upstream slope, full pond, seismic and gravity loads	1.2
	3: upstream slope, 20 ft rapid drawdown, gravity loads only	1.3

References;

1. US Army Corp of Engineers, "Recommended Guidelines for the Safety Inspection of Dams", ER-1110-2-106, 26 Sept 79. Department of the Army, Office of the Chief of Engineers, Washington, D.C.
2. US Department of The Interior, Bureau of Reclamation, Design of Small Dams, Third Edition, 1987,Washington, D.C.
3. G. Mesri, "Cohesion Intercept in Effective Stess-Stability Analysis", ASCE Journal of Geotechnical Engineering, August 1993.

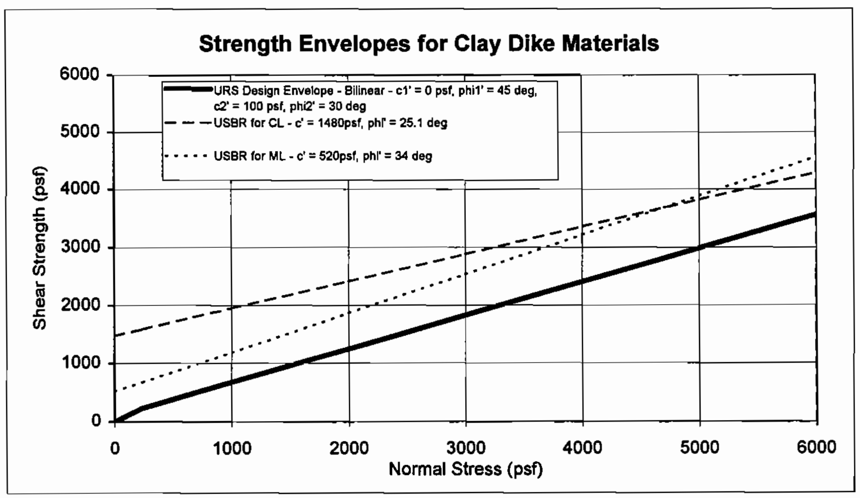
Table 1

Summary of Material Properties used for Slope Stability Analyses
Dynegy-Vermilion
23-20020051.00

Soil Location	Soil Description	Undrained Properties			Drained Properties			Seismic Properties		
		Unit Weight (pcf)	Cohesion (psf)	Phi Angle (degree)	Unit Weight (pcf)	Cohesion (psf)	Phi Angle (degree)	Unit Weight (pcf)	Cohesion (psf)	Phi Angle (degree)
Existing Dike*	Sandy/gravelly clay	137	2000	0	137	*	*	137	*	*
New Dike*	Sandy/gravelly clay	137	2000	0	137	*	*	137	*	*
Native Glacial Till	Sandy/gravelly clay	137	2000	0	137	0	30	137	0	30
Alluvium top 5 ft	CL and ML	120	1500	0	120	0	28	120	0	28
Alluvium bott. 5 ft	l-m dense SM	120	0	30	120	0	30	120	0	30
Sand &Gravel Fill	SW-GW	130	0	36	130	0	36	130	0	36
Weak Shale (2 ft)	Hard CH	140	2000	0	140	400	18	140	400	18
Shale	Shale	140	5000	0	140	1000	25	140	1000	25
Bottom Ash	loose SW-GW	97	0	30	97	0	30	97	0	30

Notes: Engineering properties based on judgement and typical properties in DM-7and the USBR Small Dams Book using available index properties and soil descriptions. Bottom ash properties based on data from the Baldwin Ash Pond.

* Clay dike materials modeled using bilinear envelope as shown below. Dike is typically low plastic clay with sand and gravel (CL), Liquid limit ~ 23, PI~ 8.



URS CORPORATION

File 23-2002 0051.00 00006

Made by ANR Date 4/29/02

Checked by [initials] Date 4-30-02

FOR Dynegy - Illinois Power - Vermilion Plant

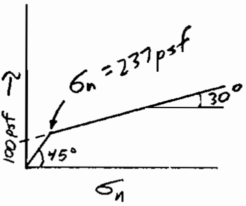
Slope Stability - all slope/w files located U:geo/Dynegy - Vermilion/stability/4-29-02/...

Problem: Evaluate slope stability of the dike raise at Vermilion Plant. Determine critical sections, evaluate soil properties, and calculate stability of slopes for the following cases: (1) Gravity loads on (A) downstream slope (D/S) and (B) upstream slope (U/S), (2) seismic loading on (A) D/S slope and (B) U/S slope, and (3) rapid drawdown condition.

Given:
(1) Plans for east ash pond extension prepared by Illinois Power (IP)
(2) Dynegy - Vermilion Illinois Power calculations/documents
(3) additional boring logs provided by IP
(4) contour plot showing top of shale elevations provided by IP (See pg 2)
(5) Vermilion Power Station East Ash Pond Expansion Drawdown Plan (See pg 3)

Solution: Critical sections: see pg 4
(1) Plan section 1: southeast corner of pond.
(2) Plan section 5: north of primary pond and south of secondary pond

Cross sections used based on given (1), (3), and (4) above.



Engineering properties used based on correlations and judgement using index properties and soil descriptions. Bottom ash properties based on data from Baldwin Ash Pond. Summary of material properties used included in Table D-1. (See pg 5) Dike materials generally are CL to CL/ML. See pg 6 for USBR soil properties. Clay dike materials modeled with bilinear envelope as at left. Water level in secondary pond modeled at 593' for critical section 2 near normal operating level.

Solution summary:

Critical Section 1:

	F.S.	pg	File name
Case 1A: gravity only, D/S	1.9	7-8	51-C1a
1B: gravity only, U/S	2.1	9-10	51-C1b
2A: seismic a=0.025g, D/S	1.8	11-12	51-C2a
2B: seismic a=0.025g, U/S	1.8	13-14	51-C2b
3: rapid drawdown	1.3	15-16	51-C3

Critical Section 2:

	F.S.	pg	File name
Case 1A: gravity only, D/S	1.5	17-18	52-C1a
1B: gravity only, U/S	1.5 *	19-20	52-C1b
2A: seismic a=0.025g, D/S	1.4	21-22	52-C2a
2B: seismic a=0.025g, U/S	1.2	23-24	52-C2b
3: rapid drawdown	1.3	25-26	52-C3

* Minor sloughing <1 ft deep had F.S. = 1.44 for new bottom ash. Factor of safety reported is for failure circle deeper than 1 ft into slope.

Conclusion: All slopes analyzed have adequate Factors of Safety (i.e. ≥1.5 gravity - case 1, ≥1.0 seismic - case 2, ≥1.2 rapid drawdown - case 3)

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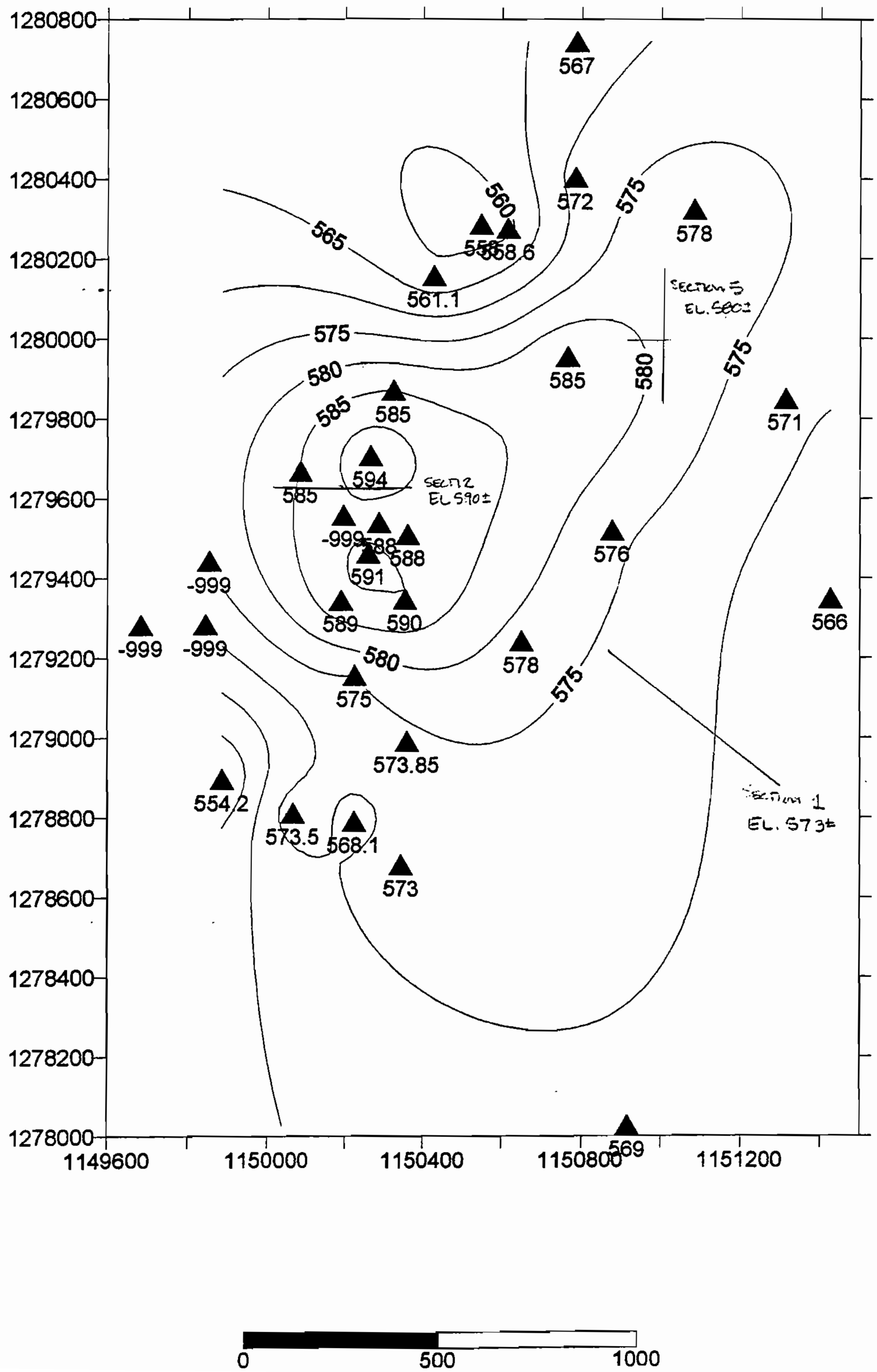
Top of Shale Elevation Map



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Vermilion Power Station
East Ash Pond Expansion
Drawdown Plan

The expansion of the east ash pond at Vermilion will add approximately 329 acre feet of water to the existing pond from elevation 600 to elevation 616. Below elevation 600 the pond is essentially full of ash and was not considered in the analysis.

There are three components to be used to lower the water elevation from elevation 616 to 608. They are: a 12" diameter pipe gravity system, a permanent pump at the pond, and a portable pump located at the plant.

One half of the water volume is approximately 54,000,000 gallons.

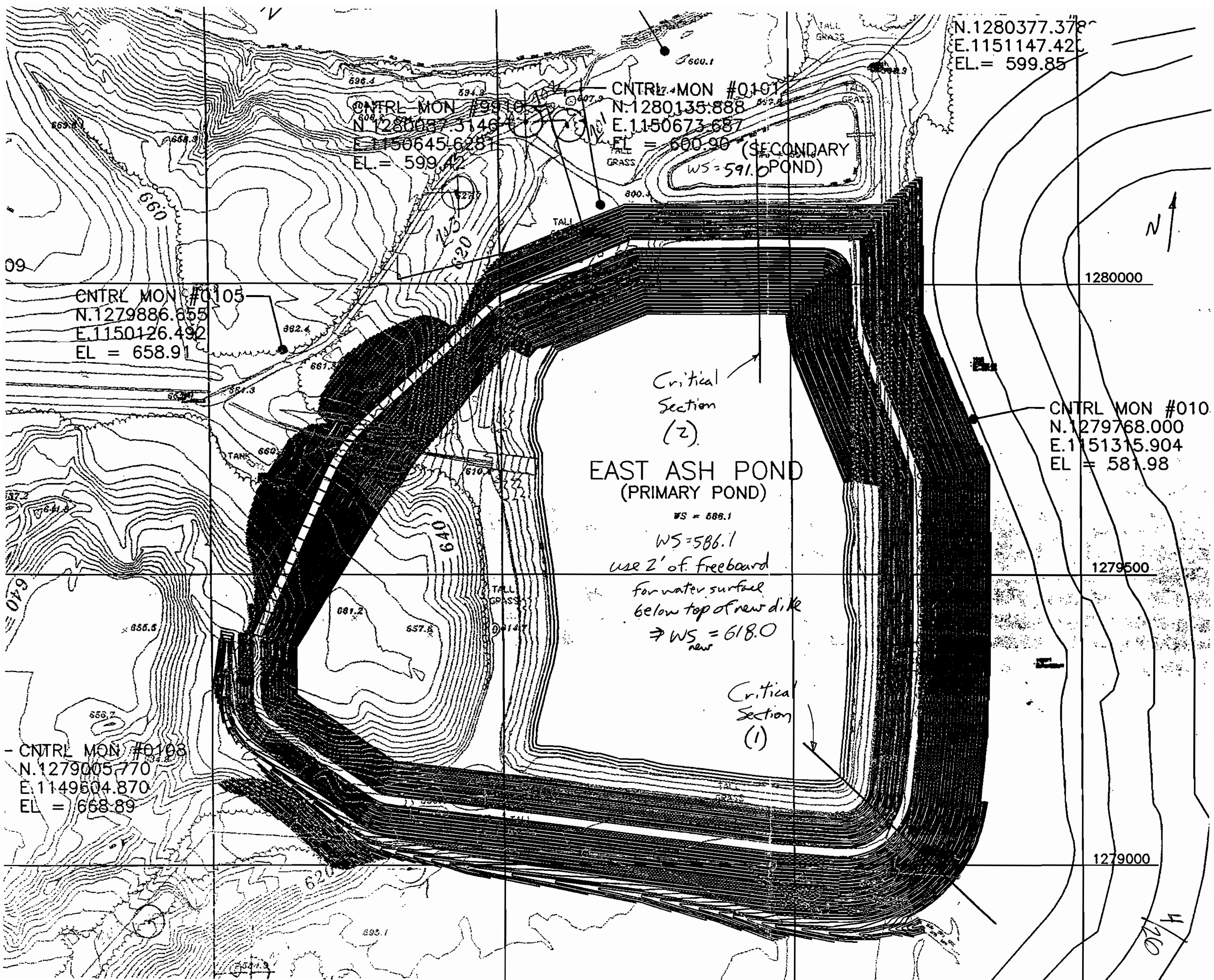
If we use all systems to expedite the removal of the water:

Pump at Pond	500 gal/min
Pump on Site	1,500 gal/min
Gravity System Average Flow at Elevation 612	2,000 gal/min
	4,000 gal/min

At this rate it will take approximately 10 days to lower the pond to ½ of its level, faster than the 30 day requirement for a Class III dam. Utilizing only the pumps it would take approximately 20 days to lower the pond level.

If an emergency required a quicker drawdown, earthworking equipment and materials would be brought in to create a controlled breach of the embankment.

April, 2002



N.1280377.378
E.1151147.420
EL.= 599.85
CNTRL MON #0101
N.1280135.888
E.1150673.687
EL = 600.90
CNTRL MON #9910
N.1280037.3146
E.1150645.6281
EL.= 599.42
(SECONDARY POND)
WS = 591.0
TALL GRASS
CNTRL MON #0105
N.1279886.655
E.1150126.492
EL = 658.91
N
1280000
CNTRL MON #010
N.1279768.000
E.1151315.904
EL = 581.98
Critical Section (2)
EAST ASH POND
(PRIMARY POND)
WS = 586.1
WS = 586.1
use 2' of freeboard
for water surface
below top of new dike
⇒ WS new = 618.0
1279500
Critical Section (1)
CNTRL MON #0108
N.1279005.770
E.1149604.870
EL = 668.89
1279000
660
640
620
4/26

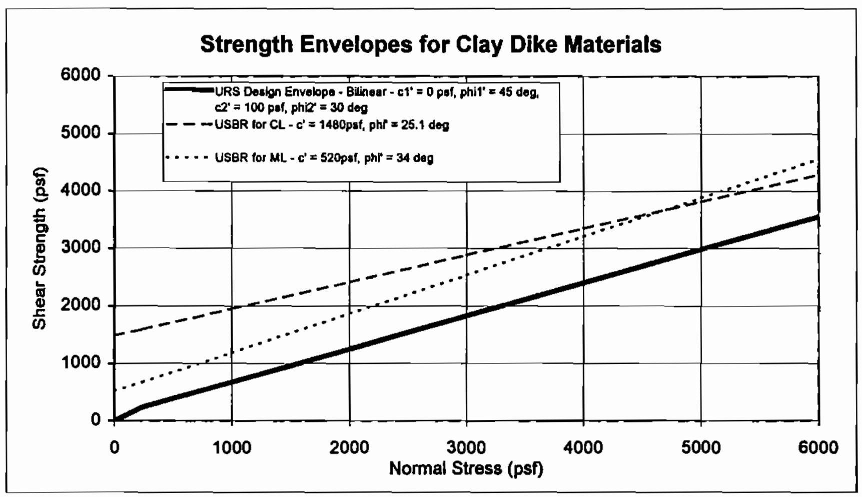
Table 1

Summary of Material Properties used for Slope Stability Analyses
Dynegy-Vermilion
23-20020051.00

Soil Location	Soil Description	Undrained Properties			Drained Properties			Seismic Properties		
		Unit Weight (pcf)	Cohesion (psf)	Phi Angle (degree)	Unit Weight (pcf)	Cohesion (psf)	Phi Angle (degree)	Unit Weight (pcf)	Cohesion (psf)	Phi Angle (degree)
Existing Dike*	Sandy/gravelly clay	137	2000	0	137	*	*	137	*	*
New Dike*	Sandy/gravelly clay	137	2000	0	137	*	*	137	*	*
Native Glacial Till	Sandy/gravelly clay	137	2000	0	137	0	30	137	0	30
Alluvium top 5 ft	CL and ML	120	1500	0	120	0	28	120	0	28
Alluvium bott. 5 ft	l-m dense SM	120	0	30	120	0	30	120	0	30
Sand &Gravel Fill	SW-GW	130	0	36	130	0	36	130	0	36
Weak Shale (2 ft)	Hard CH	140	2000	0	140	400	18	140	400	18
Shale	Shale	140	5000	0	140	1000	25	140	1000	25
Bottom Ash	loose SW-GW	97	0	30	97	0	30	97	0	30

Notes: Engineering properties based on judgement and typical properties in DM-7and the USBR Small Dams Book using available index properties and soil descriptions. Bottom ash properties based on data from the Baldwin Ash Pond.

* Clay dike materials modeled using bilinear envelope as shown below. Dike is typically low plastic clay with sand and gravel (CL), Liquid limit ~ 23, PI~ 8.



Vermilion Power Station East Ash Pond Expansion Slope Stability Analysis	20 March 2002 D.M. Gaskins

Introduction

The expansion of the east ash pond will involve numerous embankment and slope configurations as shown in the plans. The complexity of the design is a variety of factors including:

- The need to maintain a continuous eight-foot thick clay liner/core for groundwater protection
- The existing site geometry
- The variability of the on-site borrow materials
- The limited quantity of borrow material suitable for the liner/core

These calculations show the worst case situations. By showing these cases meet the slope stability safety requirements, it can be concluded that all other slope conditions have an adequate factor of safety. Adequate factors of safety were taken to be 1.5 for gravity loads and 1.0 for seismic loads.

Two critical embankments were identified. The first (Embankment #1) is near the southeast corner of the pond. This is the tallest embankment with a downstream height of 48 feet. The second critical embankment (Embankment #2) is between the expanded primary pond and the existing polishing pond. The polishing pond will not be expanded or modified by this project.

The following load cases were checked for each of these two slopes.

a) Downstream stability with the pond full of water – gravity loads only
b) Upstream stability with the pond full of water – gravity loads only
c) Downstream stability with the pond full of water – seismic and gravity loads applied
d) Upstream stability with the pond full of water – seismic and gravity loads applied
e) Upstream stability after rapid drawdown of the pond – gravity loads only

These calculations do not take into account effects of possible mine subsidence during or after construction. See other portions of the calculation package for coverage of this issue.

Slope stability was analyzed using the computer program "Slope/W" from Geo-Slope International. Slope/W computed the safety factor using four different methods: Ordinary, Bishop, Janbu, and Spencer. Results of the Spencer method are shown for all cases. In all cases, the these four methods computed safety factors reasonably close to each other.

For case 2c, the results from the Janbu method is also included because the critical slip surface determined by the Spencer method did not appear to be a reasonable failure mode. The Janbu method predicted a failure mode more in line with expectations. The safety factors computed for case 2c by the Janbu and Spencer methods varied by only 7%.

Embankment Modeling

Construction of the embankments will utilize the available on-site materials. Soil borings indicate an adequate amount of quality clay (permeability less than 10^{-6} cm/sec) to construct the liner/core. Lesser quality clay will be used for most of the remaining volume in the embankments.

Granular materials will be used in selected areas. The lower portions of the downstream side Embankment #1 will be constructed of sandy soil with some gravel in it. Embankment #2 will have a base of bottom ash on the upstream side. The bottom ash will be placed in the active portion of the ash pond without draining it.

The construction plans show the details of these embankments. Also, the computer output that follows shows the simplified geometry used for analysis.

To simplify the modeling and to insure a conservative analysis, only one set of values was used to define the strength of all the clayey soils used in the embankment. In reality, the high quality glacial clay tills used for the liner/core will have higher strengths than the values used in the modeling. By using the same lower-bound strength for all the clay soils used in the embankment, the complications in analysis caused by the shifting liner/core locations are avoided. Another consequence of this approach is that the computer safety factor will always be less than or equal to the actual safety factor.

All soils strengths are defined by the Mohr-Coulomb strength model. For the natural soils used in the embankment, properties where determined from remolded samples compacted to 95% of standard Proctor to correspond to the project specifications for the embankment.

For the bottom ash, safe strength parameters were chosen based on past experience. Since the bottom ash will be placed underwater, no specified compaction will be required. It is expected that subsequent construction on top of the bottom ash will sufficiently compact it to achieve the assumed strength parameters. Testing of the bottom ash during construction will verify that the assumed strengths are being achieved. If the bottom ash does not come up to strength as expected, then appropriate measures will be taken to provide additional compaction of the bottom ash. Past experience indicates than the bottom ash will actually gain significantly more strength than assumed in the slope stability calculations.

The west side of the pond will be cut into a natural hillside. Soil tests on undisturbed samples of the soils indicate that they have more strength than the remolded soils. Therefore, no analysis was done on the upstream slope on the west side.

For the rapid drawdown cases, it was assumed that the pond water level will drop 20 feet in a short period of time. I was also assumed that the high point of the piezometric line would drop only two feet.

The seismic factor used in these calculations was 0.20g. This ground acceleration was taken from ASCE 7-98, *Minimum Design Loads for Building and Other Structures*.

Soil Properties

The soil tests indicated reasonable consistency in the properties of each major type of soil. The average values for recompacted silty clay (CL-ML) and recompacted sandy soils (SM and SW-SC) were used in modeling the embankments. In the attached table, properties for the lean clay (CL) and in in-situ silty clay (CL-ML) are given for reference though these values were not used in the analysis. The CL material will be primarily used for the liner/core of the embankments.

The soil test reports are included in the calculation package.

Soil strengths were determined by undrained, unconsolidated (UU) tri-axial compression tests. All samples were unsaturated, with the remolded samples being significantly below the saturation moisture content. The consequence of this was that pore water pressure was not a significant factor in interpreting the test results. The tests provided a strength intercept (C') and phi angle (ϕ) for use in the Mohr-Coulomb strength model. *Soil Mechanics for Unsaturated Soils* by Fredlund and Rahardjo was used as a reference in interpreting the test results. (Section 9.3.4 covers the UU test of unsaturated soils.)

Results

The full computer output for the various load cases is not attached as it would take an extensive number of pages. The full output is available upon request.

Results are shown in the form of graphical computer output annotated with handwritten notes. These show that the required safety factors are provided in all cases. An attached table summarizes the results.

Summary

The slope stability safety factor for the embankments shown in the construction drawings exceed the required safety factors in all cases.

Average Soil Properties

	Remolded CL-ML	Remolded SM & SW-SC	Undisturbed CL-ML	Remolded CL	Bottom Ash
ϕ (degrees)	28.5	30.0	30.2	24.8	20
C' (psf)	1933	350	2740	2960	290
Dry density (pcf)	120	124	124	118	80
Saturation (%)	79.4	58.2	88.6	78.6	100
Moisture Content (%)	11.9	7.6	11.7	12.3	32.5
Density at saturation (pcf)	134	133	138	133	106
			For information only – Not used in slope stability analysis		Assumed values

The values given for bottom ash are assumed values based on past experience. The strength values for bottom ash are conservatively low. Actual strength is expected to be higher. Actual values for bottom ash will be confirmed with a testing program during construction.

Slope Stability Safety Factors

			Analysis Conditions			
Embankment	Load Case	Factor of Safety	Downstream Slope analyzed	Upstream Slope analyzed	Rapid Draw-down conditions	Seismic Loads Included
1	a	1.81	X			
1	b	7.54		X		
1	c	1.03	X			X
1	d	3.29		X		X
1	e	4.83		X	X	
2	a	4.35	X			
2	b	4.15		X		
2	c	2.37	X			X
2	d	1.77		X		X
2	e	2.35		X	X	

URS **EXHIBIT 4.7-2**

CALCULATION COVER SHEET

Client: Dynegy Midwest Project Name: Dynegy - Vermilion

Project/Calculation Number: 23-20020051.00

Title: Hydro CALCULATIONS

Prepared by: William Long Date: 6/17/02

Checked by: [signature] Date: 6/24/02

Description and Purpose:*

Design Basis/References/Assumptions*

Remarks/Conclusions/Results:*

Calculation Approved by: ____________________
Project Manager/Date

Revision No.:	Description of Revision:			
1		WDL/6/14/02		
2				
3				
		Prepared By/ Date	Checked By/ Date	Project Mgr./ Date

*(attachments okay)

Dynegy – Vermilion Plant
East Ash Pond Expansion
Hydraulic/Hydrologic Analysis by URS

1.0 Introduction

URS has reviewed the Hydraulic/Hydrology analyses done by Illinois Power as described in the April 2002 report and to conform with typical procedures used by URS. URS performed additional hydraulic/hydrologic analysis. The URS analysis is then described in detail.

2.0 Illinois Power Provided Hydraulic/Hydrologic Analysis

Illinois Power provided the following analysis:

- **Drawdown Plan** – The requirements for drawdown is half the pond volume in 30 days. The system that is planned for the new pond, 2 pumps and a 18 inch diameter gravity feed pipe, will drawdown half the pond volume in 10 days. The pumps alone will do the same in 20 days. Both plans exceed the requirement.

  We verified the volume of the pond and the average flow rate of the discharge pipe. To check drawdown time URS divided volume of the pond in half and then divided that by the flow rates for the pipe and pumps. The rates were given to us and seem reasonable.

- **Freeboard Height** – The required freeboard height is 1.5 feet minimum. The design has 2 feet of freeboard. URS found an error in the calculations of Fetch 2, so, two additional fetches were checked. Fetch 1 and 2 were equal in size and the largest fetches. The rest of the analysis was correct.

  URS was unable to obtain the reference listed by Illinois Power to verify their method. URS was able to verify the method with the use of different publications.

- **Outfall System** – Illinois Power analized the Outfall System using the HEC-1 software. The state requirement is for the system to be design for a 100-year rainfall.

  URS checked the HEC-1 analysis by checking and verifying the input data. We then followed through the report of the final analysis. The 100-year rainfall will raise the level of the pond 0.8 tenths of a foot. URS agrees with the results of the HEC-1 analysis.

- **Effect on 100 year Floodwater Surface Elevation of the Middle Fork River** – Illinois Power performed an HEC-RAS analysis the effect of the dike expansion on the 100-year flood surface elevation.

  URS requested all the electronic files for the HEC-RAS analysis. We checked the geometry files to the existing and proposed dike. We ran various sections to verify the output diagrams. Finally we reran the program and generated the output report and compared it to the output data provided by Illinois Power. URS believes that the output results are reasonable.

  The expansion of the dike will raise the 100-year flood elevation approximately 3 inches. This is allowable per an email from Robert Giesing of IDNR OWR dated 4/26/02. Robert has reviewed a hard copy of the analysis and said "The increase in water surface is minimal and meets our criteria."

3.0 URS Hydraulic/Hydrologic Analysis

URS preformed the following analysis:

- **Capacity of Stormwater Diversion Channel** – URS determined the capacity of the stormwater diversion channel as designed. The capacity of the channel is 176 cfs. URS calculated the total runoff of the watershed draining into the channel; the total runoff is 37 cfs. The stormwater diversion channel is oversized for the demand.

- **Capacity of Spillway into Pond** – URS designed a new spillway into the ash pond. The spillway will handle the building discharge and the coal pile runoff. The amount of discharge from the above mentioned is 4.5 cfs.

  The spillway has a capacity of 400 cfs. The spillway is over sized to allow a large base for the discharge pipe to be laid side by side and allow for expansion of the HDPE. The coal pile runoff channel also discharges into the spillway.

- **Weir from Upper Pond to Lower Pond** – URS designed a seperation dike and weir to help protect the liner of the upper area of the pond. The dike is 2 feet high with a 15 feet long concrete weir. The weir has a capacity of 50 cfs. The weir is sized for the 100-year rainfall event.

- **Combined Primary Intake** – URS designed combined two existing intake systems in to one. The pump intake and the controlled discharge system shall be combined. URS analyzed the flow required for the combined system and the capacity of the piping being used. There is more then adequate flow. The two systems would operate at the same time only in a dewatering situation.

FOR CMP Culvert

GIVEN: Pipe Dia = 36 inches
Cover = 1.5 inches
Liveload LL = H20
WEIGHT of Soil, w = 120 lb/ft^3

Design Pressure

$P_v = .86(DL+LL)$ DL = H x 120 = 1.5 (120) = 180 psf

From TABLE 7.1
LL = 1300 psf

$P_v = .86(180 + 1300) = 1272.8$ psf

Ring Compression

$C = P_v \times \frac{S}{2}$ S = Span, ft

$C = 1272.8 \times \frac{3}{2} = 1909.2$

Allowable Wall stress

$f_c = \frac{f_b}{2}$ $r = \sqrt{I/A}$ for $2\frac{2}{3} \times \frac{1}{2}$ corrugation $r_{min} = .17$

$\frac{D}{r_{min}} = \frac{36}{.17} = 211.8 < 294$

$\therefore f_b = f_y = 33{,}000$ psi

$f_c = \frac{33{,}000}{2} = 16{,}500$ psi

Wall CROSS-SECTIONAL AREA

$A = \frac{C}{f_c} = \frac{1909.2}{16{,}500} = .1157$ in²/ft .052 18 gage galvanized min

USING 10 gage.

pg 198 - 200 in "Modern Sewer Design" 3rd Edition 1995

Table 7.1 Highway and Railway Live Loads (LL)

Highway loading[1]			Railway E-80 loading[1]	
Depth of Cover (feet)	Load, psf H-20	Load, psf H-25	Depth of Cover (feet)	Load, psf
1	1800	2280	2	3800
2	800	1150	5	2400
3	600	720	8	1600
4	400	470	10	1100
5	250	330	12	800
6	200	240	15	600
7	175	180	20	300
8	100	140	30	100
9	—	110	—	—

Notes: 1. Neglect live load when less than 100 psf; use dead load only.

Dead Loads

The dead load is considered to be the soil prism over the pipe. The unit pressure of this prism acting on the horizontal plane at the top of the pipe is equal to:

$$DL = wH \quad (1)$$

where: w = Unit weight of soil, kN/m^3 (lb/ft^3)
H = Height of fill over pipe, m (ft)
DL = Dead load pressure, kPa (lb/ft^2)

Design Pressure

When the height of cover is equal to or greater than the span or diameter of the structure, the total load (total load is the sum of the live and dead load) can be reduced by a factor of K which is a function of soil density.

For 85% Standard Density K = 0.86
For 90% Standard Density K = 0.75
For 95% Standard Density K = 0.65

The recommended K value is for a Standard Density (AASHTO T-99 or ASTM D98) of 85%. This value easily will apply to ordinary installations in which most specifications will call for compaction of 90%. However, for more important structures in high fill situations, select a higher quality backfill at a higher density and specify the same in construction. This will extend the allowable fill height or save on thickness. If the height of cover is less than one pipe diameter, the total load (TL) is assumed to act on the pipe, and TL = P_V. In summary:

$$P_V = K(DL + LL), \text{ when } H \geq S \quad (2)$$
$$P_V = (DL + LL), \text{ when } H < S$$

Table 7.2M Moment of Inertia (I) and Cross-Sectional Area (A) of Corrugated Steel for Underground Conduits

Corrugation Profile (mm)	Specified Thickness[1], mm									
	1.32	1.63	2.01	2.77 2.82	3.51 3.56	4.27 4.32	4.79	5.54	6.32	7.11
	Moment of Inertia, I, mm⁴/mm									
38 x 6.5	5.62	7.19	9.28	14.06	19.79	26.75				
51 x 13	25.11	31.80	40.27	58.01	79.99	98.14				
68 x 13	24.58	31.00	39.20	56.13	74.28	93.82				
75 x 25	112.9	141.8	178.3	253.3	330.6	411.0				
125 x 25		145.0	181.8	256.5	332.9	411.2				
152 x 51				990.1	1281	1576	1770	2080	2395	2718
19 x 19 x 190[2]		46.23	60.65	90.74	121.81					
19 x 25 x 292[2]		75.05	99.63	151.7						
	Cross-Sectional Wall Area, mm²/mm									
38 x 6.5	1.287	1.611	2.011	2.817	3.624	4.430				
51 x 13	1.380	1.725	2.157	3.023	3.890	4.760				
68 x 13	1.310	1.640	2.049	2.870	3.692	4.515				
75 x 25	1.505	1.884	2.356	3.302	4.250	5.203				
125 x 25		1.681	2.100	2.942	3.785	4.627				
152 x 51				3.294	4.240	5.184	5.798	6.771	7.743	8.719
19 x 19 x 190[2]		1.077	1.507	2.506	3.634					
19 x 25 x 292[2]		0.792	1.109	1.869						

Notes: 1. Where two thicknesses are shown, top is corrugated steel pipe and bottom is structural plate.
2. Ribbed pipe. Properties are effective values.

Table 7.2 Moment of Inertia (I) and Cross-Sectional Area (A) of Corrugated Steel for Underground Conduits

Corrugation Profile (inches)	Specified Thickness[1], inches									
	0.052	0.064	0.079	0.109 0.111	0.138 0.140	0.168 0.170	0.188	0.218	0.249	0.280
	Moment of Inertia, I, in.⁴/ft									
$1^1/_2 \times {}^1/_4$	.0041	.0053	.0068	.0103	.0145	0.0196				
$2 \times {}^1/_2$	.0184	.0233	.0295	.0425	.0586	0.0719				
$2^2/_3 \times {}^1/_2$	.0180	.0227	.0287	.0411	.0544	0.0687				
3 x 1	.0827	.1039	.1306	.1855	.2421	0.3010				
5 x 1		.1062	.1331	.1878	.2438	0.3011				
6 x 2				.725	.938	1.154	1.296	1.523	1.754	1.990
${}^3/_4 \times {}^3/_4 \times 7^1/_2$ (2)		.0431	.0569	.0858	0.1157					
${}^3/_4 \times 1 \times 11^1/_2$ (2)		.0550	.0730	.1111						
	Cross-Sectional Wall Area, in.²/ft									
$1^1/_2 \times {}^1/_4$	.608	.761	.950	1.331	1.712	2.093				
$2 \times {}^1/_2$	.652	.815	1.019	1.428	1.838	2.249				
$2^2/_3 \times {}^1/_2$	.619	.775	.968	1.356	1.744	2.133				
3 x 1	.711	.890	1.113	1.560	2.008	2.458				
5 x 1		.794	.992	1.390	1.788	2.196				
6 x 2				1.556	2.003	2.449	2.739	3.199	3.658	4.119
${}^3/_4 \times {}^3/_4 \times 7^1/_2$ (2)		.511	.715	1.192	1.729					
${}^3/_4 \times 1 \times 11^1/_2$ (2)		.374	.524	.883						

Notes: 1. Where two thicknesses are shown, top is corrugated steel pipe and bottom is structural plate.
2. Ribbed pipe. Properties are effective values.

DESCRIPTION OF CORRUGATIONS

There are many kinds of corrugations, some of which are shown in Fig. 2.3. Corrugations commonly used for pipes or conduits are termed circular arcs connected by tangents, and are described by pitch, depth and inside forming radius. Pitch is measured at right angles to the corrugations from crest to crest.

For riveted or resistance spot-welded pipe with circumferential (annular) seams, the corrugations are of 2 ⅔ in. pitch by ½ in. depth and 3 in. by 1 in.

For lock seam pipe, the seams and corrugations run helically (or spirally) around the pipe. For small diameters of subdrainage pipe (6,8,10 in., etc.) the pitch vs. depth dimension is 1 ½ × ¼ in. Larger sizes (diameters to 144 in. depending on profile) use 2× ½ in., 2 ⅔ × ½ in., 3 × 1 in. and 5 × 1 in. corrugations.

The most recent corrugation introduced was Spiral Rib profiles. Developed in the mid 1980's, the pipe wall is spirally formed using rectangularly formed ribs between flat wall areas. This unique profile configuration was developed for providing flow characteristics equal to those piping systems normally considered smooth wall. Two profile configurations are available - ¾ in. × ¾ in. x 7 ½ in. and ¾ in. × 1 in. x 11 ½ in. (covering diameters from 18 in. through 108 in.)[1,2]

Structural plate pipe is a bolted structure. The 6 × 2 in. corrugation is the standard of the American Association of State Highway and Transportation Officials. The most recent profile introduced for structural plate is the 15 × 5 ½ in. deep corrugation profile.[3,4]

SECTIONAL PROPERTIES

Sectional properties of the arc-and-tangent type of corrugation are derived mathematically.[5] These include area, A, moment of inertia, I, section modulus, S, and radius of gyration, r. Research by the American Iron and Steel Institute[6] has shown that failure loads in bending and deflection within the elastic range can be closely predicted by using computed sectional properties of the corrugated sheet. See Tables 2.3 through 2.11.[5,7,8]

Table 2.2 Conversion of Nominal Gage to Thickness

Gage No.	22	20	18	16	14	12
Uncoated Thickness — in.	0.0299	0.0359	0.0478	0.0598	0.0747	0.1046
Galvanized Thickness* — in.	0.034	0.040	0.052	0.064	0.079	0.109
Galvanized Structural Plate Thickness — in.						0.111
Galvanized Thickness — mm	0.762	1.02	1.32	1.63	2.01	2.77

Gage No.	10	8	7	5	3	1
Uncoated Thickness — in.	0.1345	0.1644	0.1838	0.2145	0.2451	0.2758
Galvanized Thickness* — in.	0.138	0.168				
Galvanized Structural Plate Thickness — in.	0.140	0.170	0.188	0.218	0.249	0.280
Galvanized Thickness — mm	3.5	4.27	4.78	5.54	6.32	7.11

*Also referred to as specified thickness for corrugated steel pipe products.
For structural plate, tunnel liner plates, guiderail and other products, see chapters on those products.

URS CORPORATION

Sheet No. 1 Of

File ______

Made by WDL Date 5/29/02

Checked by MJB Date 6/26/02

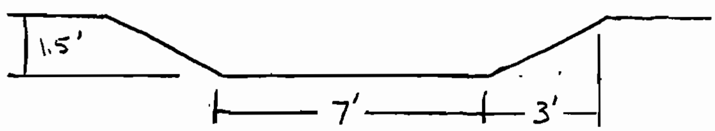
FOR SPILLWAY CHANNEL INTO ASH POND
FOR BUILDING/COAL PILE RUNOFF

AREA	WETTED PERIMETER	HYDRAULIC RADIUS
$(b+zy)y$	$b+2y\sqrt{1+z^2}$ $b+2\sqrt{z^2+y^2}$	A/wp
$[(7+\cancel{2}^{3}(1.5))]1.5$	$7+2(1.5)\sqrt{1+2^2}$ $7+2\sqrt{1.5^2+3^2}$	$15/13.7$
$15\ ft^2$ ✓	13.7 ft ✓	1.09 ✓

$n = .033$ GRAVEL BOTTOM w/SIDES of Riprap ✓

$\phi = 1.49$ ENGLISH UNITS ✓

$S = \Delta H/L = 20/63.25 = .316$ ✓



$z = \cancel{2}\ 3$
$y = 1.5$ ft
$b = 7$ ft

20' is the elevation change of spillway + 63.25 is length of spillway taken from contour drawing

$$Q = VA = \frac{\phi}{n} A R^{2/3} \sqrt{S}$$

$$= \frac{1.49}{.033}(15)(1.09^{2/3})(\sqrt{.316})$$

$$= \underline{\underline{403.23\ cfs}}$$ ✓

capacity
vs
flow?

URS CORPORATION

Sheet No. 1 Of 1

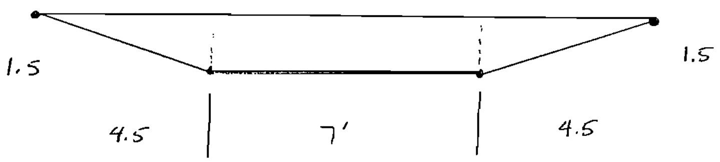
File ______

Made by WDL Date 5/29/02

Checked by ______ Date ______

FOR CHANNEL\SPILLWAY INTO ASH POND FOR BUILDING/COAL PILE RUN OFF

$Y = 18 \text{ in}$



AREA	WETTED PERIMETER	Hydraulic Radius	Top WIDTH	HYDRAULIC ~~DEPTH~~
$(b+zy)y$	$b+2y\sqrt{1+z^2}$	$\frac{A}{WP}$	$b+2zy$	$\frac{A}{TW}$
$[7+3(1.5)]1.5$	$7+2(1.5)\sqrt{1+3^2}$	$17.3/16.5$	$7+2(1.5)(3)$	$17.3/16$
17.3	16.5	1.05	16	1.08

$n = .033$ GRAVEL BOTTOM WITH SIDES OF RIPRAP

$A = 17.3$

$\phi = 1.49$ english units

$R = 1.05$

$S \quad \Delta H/L = \frac{20}{63.25} = .316$

1.033 .562

$Q = VA = \frac{\phi}{n} A R^{2/3} \sqrt{S} = \frac{1.49}{.033}(17.3)(1.05^{2/3})(\sqrt{.316}) = \underline{\underline{453.62 \text{ cfs}}}$ or > 25.6 :1

size is sufficient

2:1 slope

Area	WETTED PERIMETER	Hydraulic Radius	Top Width	Hydraulic Depth
15	13.7	1.09	13	1.15

$Q = \frac{1.49}{.033}(15)(1.09^{2/3})(\sqrt{.316}) = \underline{\underline{403.23 \text{ cfs}}}$ ✓

URS CORPORATION

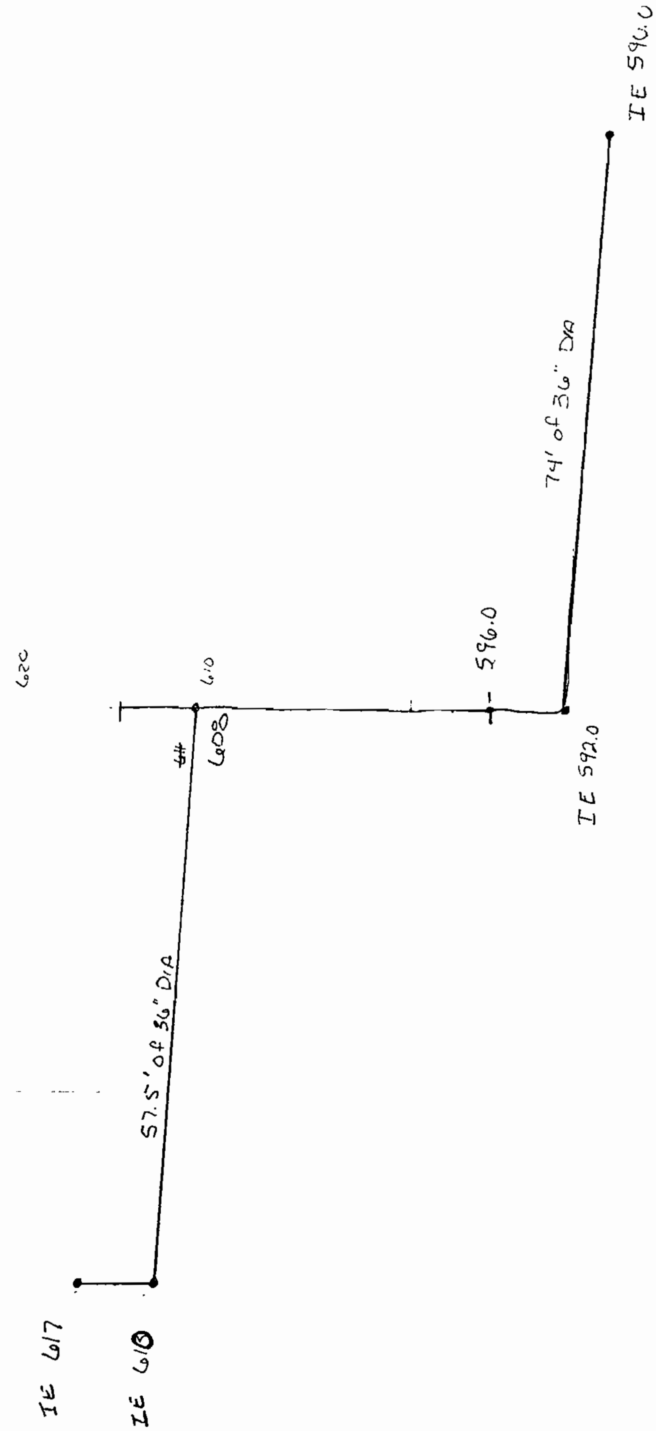
File DYNEGY

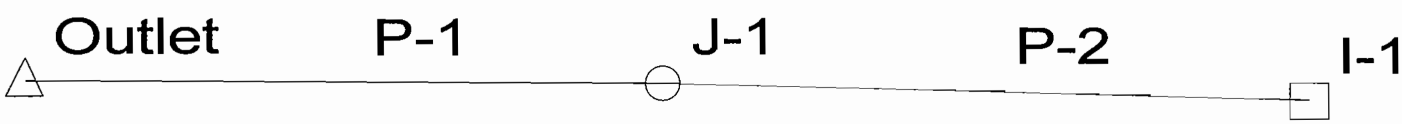
Made by WDL Date 5/20/02

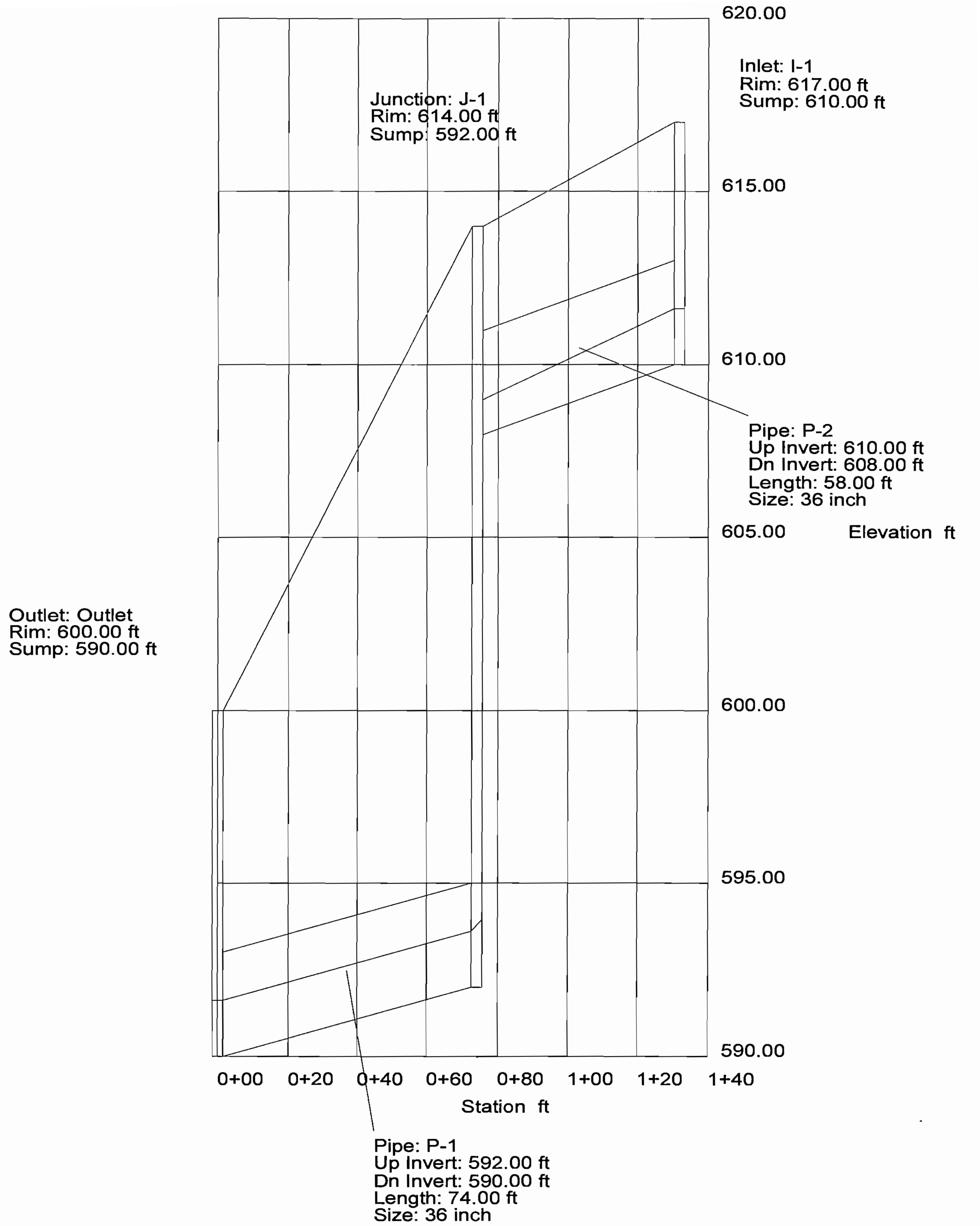
Checked by MJB Date 6/24/02

FOR DETERMINE IF ANY PRESSURE ~~IN OUTF~~ FLOW IN OUTFALL SYSTEM.

P23, 28-30 $Q = KH^{2.5}$




Outlet
P-1
J-1
P-2
I-1



620.00
Inlet: I-1
Rim: 617.00 ft
Sump: 610.00 ft
Junction: J-1
Rim: 614.00 ft
Sump: 592.00 ft
615.00
610.00
Pipe: P-2
Up Invert: 610.00 ft
Dn Invert: 608.00 ft
Length: 58.00 ft
Size: 36 inch
605.00
Elevation ft
Outlet: Outlet
Rim: 600.00 ft
Sump: 590.00 ft
600.00
595.00
590.00
0+00
0+20
0+40
0+60
0+80
1+00
1+20
1+40
Station ft
Pipe: P-1
Up Invert: 592.00 ft
Dn Invert: 590.00 ft
Length: 74.00 ft
Size: 36 inch

```
------------------ Beginning Calculation Cycle -------------------
Discharge: 25.00 cfs  at node I-1
Discharge: 25.00 cfs  at node J-1
Discharge: 25.00 cfs  at node Outlet
Beginning iteration 1
Discharge: 25.00 cfs  at node I-1
Discharge: 25.00 cfs  at node J-1
Discharge: 25.00 cfs  at node Outlet
Discharge Convergence Achieved in 1 iterations: relative error:  0.0
** Warning: Design constraints not met.
Warning: No Duration data exists in IDF Table
Information: Outlet Known flow propogated from upstream junctions.
Warning: Outlet Assumption of critical depth free discharge not valid for
steep pipes. (Normal depth recommended)
Information: J-1 Known flow propogated from upstream junctions.
Violation: P-2 does not meet minimum cover constraint at downstream end.
--------------------- Calculations Complete ---------------------

** Analysis Options **
Friction method:  Manning's Formula
HGL Convergence Test:  0.001000
Maximum Network Traversals:  5
Number of Pipe Profile Steps:  5
Discharge Convergence Test:  0.001000
Maximum Design Passes:  3


 ---------------- Network Quick View -----------------------
```

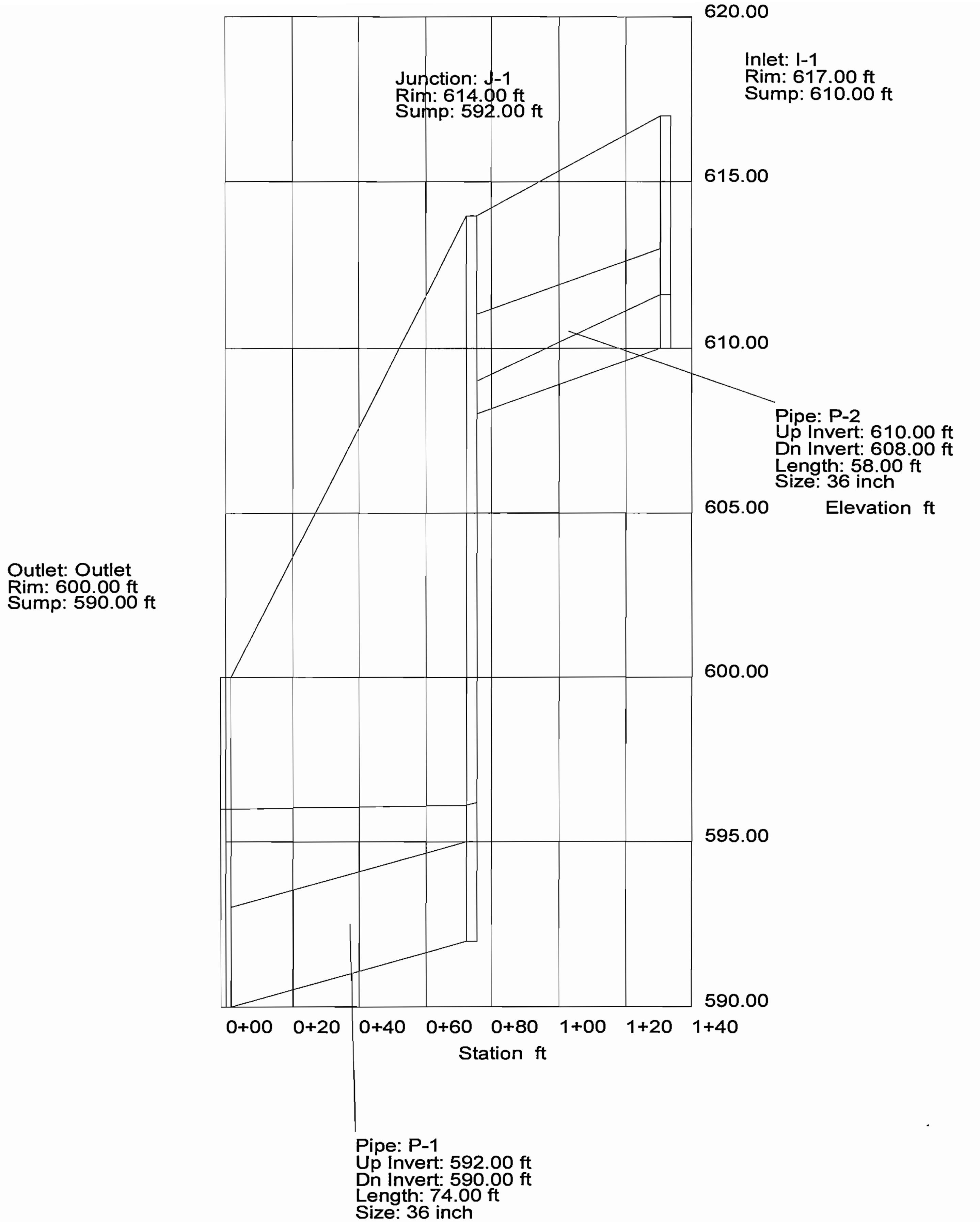
Label	Length	Size	Discharge	Hydraulic Grade Upstream	Hydraulic Grade Downstream
P-1	74.00	36 inch	25.00	593.61	591.61
P-2	58.00	36 inch	25.00	611.61	609.00

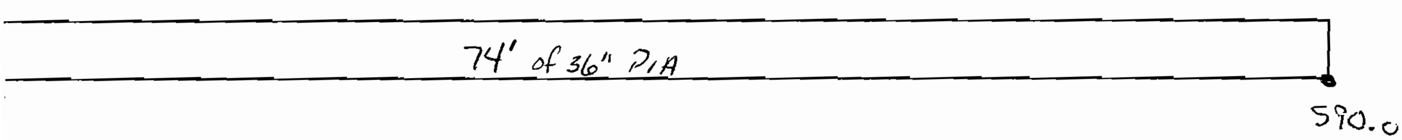
Label	Discharge	Elevations Ground	Elevations Upstream HGL	Elevations Downstream HGL
Outlet	25.00	600.00	591.61	591.61
J-1	25.00	614.00	593.94	593.61
I-1	25.00	617.00	611.61	611.61

Elapsed: 0 minute(s) 0 second(s)

Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Inlet C	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Description
P-2	I-1	J-1	58.00	0.00	0.00	0.00	0.00	0.00	36 inch	123.85	9.29	610.00	608.00	0.034483	
P-1	J-1	Outlet	74.00	N/A	N/A	N/A	0.00	N/A	36 inch	109.65	6.45	592.00	590.00	0.027027	


620.00
615.00
610.00
605.00
600.00
595.00
590.00
Elevation ft
Inlet: I-1
Rim: 617.00 ft
Sump: 610.00 ft
Junction: J-1
Rim: 614.00 ft
Sump: 592.00 ft
Pipe: P-2
Up Invert: 610.00 ft
Dn Invert: 608.00 ft
Length: 58.00 ft
Size: 36 inch
Outlet: Outlet
Rim: 600.00 ft
Sump: 590.00 ft
0+00
0+20
0+40
0+60
0+80
1+00
1+20
1+40
Station ft
Pipe: P-1
Up Invert: 592.00 ft
Dn Invert: 590.00 ft
Length: 74.00 ft
Size: 36 inch


74' of 36" DIA
590.0

URS CORPORATION

Sheet No. 1 Of 1

File

Made by ~~WDL~~ Dynegy Date

FOR Check Calculations FOR DRAWDOWN PLAN

Checked by WOL Date

Surface area at EL. 616 ft. 329 acres · ft = 14331200 ft^3

Depth 16 ft

Volume = 14331200 ft^3 = 107204800 gal.

Drawdown is half the volume ≈ 53602400 gal OK

Uses of all systems drawdown is 4000 gal/min

$$54000000\ \text{gal} \left| \frac{\text{min}}{4000\ \text{gal}} \right| \frac{1\ \text{hr}}{60\ \text{min}} \left| \frac{\text{day}}{24\ \text{hr}} \right. = 9.4\ \text{days} \approx 10\ \text{days}$$ OK

USE ONLY Pumps Drawdown is 20 days OK

Verified per Rules for Construction and Maintenance of Dams Pub. by OWR

Vermilion Power Station
East Ash Pond Expansion
Drawdown Plan

The expansion of the east ash pond at Vermilion will add approximately 329 acre feet of water to the existing pond from elevation 600 to elevation 616. Below elevation 600 the pond is essentially full of ash and was not considered in the analysis.

There are three components to be used to lower the water elevation from elevation 616 to 608. They are: a 12" diameter pipe gravity system, a permanent pump at the pond, and a portable pump located at the plant.

One half of the water volume is approximately 54,000,000 gallons.

If we use all systems to expedite the removal of the water:

Pump at Pond	500 gal/min
Pump on Site	1,500 gal/min
Gravity System Average Flow at Elevation 612	2,000 gal/min
	4,000 gal/min

At this rate it will take approximately 10 days to lower the pond to ½ of its level, faster than the 30 day requirement for a Class III dam. Utilizing only the pumps it would take approximately 20 days to lower the pond level.

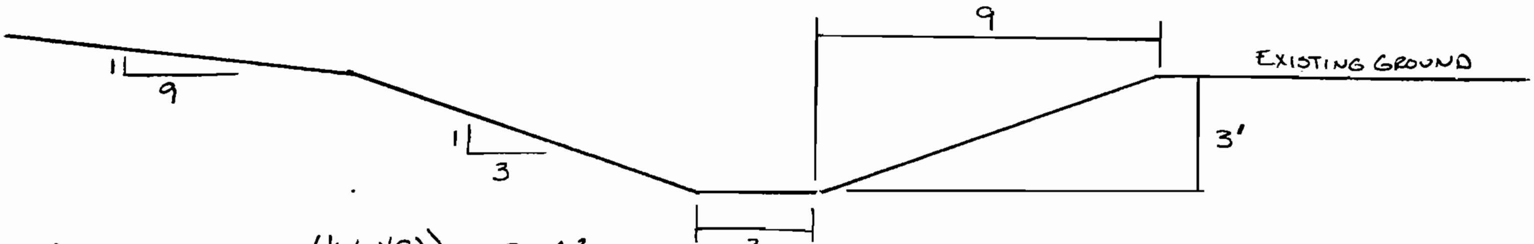
If an emergency required a quicker drawdown, earthworking equipment and materials would be brought in to create a controlled breach of the embankment.

April, 2002

Made by WDL Date 4/24/02

FOR CAPACITY OF ~~STROM~~ STORM WATER DEVERSION CHANNEL Checked by MJB Date 6/26/02

TAKEN FROM
TYPICAL SECTION 14



AREA = $3 \times 3 + 2(\frac{1}{2}(3)(9)) = 36\,ft^2$

WETTED PERIMETER = $9.5 + 3 + 9.5 = 22\,ft$

HYDRALIC RADIUS = $\frac{A}{P} = \frac{36}{22} = 1.64\,ft$

Velocity and Q max for the ~~Strom~~ STORM water DIVERSION Channel As DESIGNED

$V = \frac{\phi}{n} R^{2/3} (\sqrt{S})$ $\phi = 1.49$ ENGLISH UNITS

$R = 1.64\,ft$ MANNINGS EQUATION Pg 3.11 (3.34)

$S = \frac{\Delta H}{L} = \frac{39}{1432} = .0272$

$\Delta H = 39\,ft$ $L = 1432\,ft$ DRAWING E-VER 1-C128-1

$n = \cancel{.035}\ 0.070$ SEE ATTACHED CHART

VELOCITY @ 3 ft

$V = \frac{1.49}{.07} (1.64^{2/3}) (\sqrt{.0272}) = 4.88\,ft/s$ ✓

$Q_{max} = VA = 4.88(36) = 175.75$ cfs ✓ Capacity

URS CORPORATION

Made by WDL Date 4/24/02
Checked by MJB Date 6/26/02

FOR CALCULATING RUNOFF INTO STORM WATER CHANNEL

Rational Method

T_c = 68 min. See Attached Calculations.

i = 3.11 in/hr From TP-70.

A = 59 acres Determined from a contour Drawing; OVERALL SITE PLAN DRAWING,

C = .2 Light Turf See Attached Table 4.1

$Q = CiA$

$= .2(3.11)(59) = 36.7$ cfs flow

Q_{design} = 176 cfs > Q = 36.7 cfs CHANNEL IS OVER DESIGNED FOR STORM WATER RUNOFF.

URS CORPORATION

File ______

Made by WDL Date 5/29/02

FOR WIER SIZE FROM UPPER POND TO LOWER POND

Checked by MJB Date 6/24/02

GIVEN FLOW OF 4.5cfs FROM Plant + COAL PILE

Q upper pond

$A = 160{,}000\ ft^2 \div 3.7 \approx 4.0$ Acres.

100yr rain 5 min. duration $i = 9.5$ in/hr Bulletin 70 pg 29 Table 13

$Q = CiA$ $C = .95$ LINER CONSIDERED IMPERVIOUS

$= .95(9.5)(4.0)$

$= 36.1$ cfs ✓

TOTAL DISCHARGE

$Q_t = 4.5 + 36.1 = 40.6$ cfs ✓

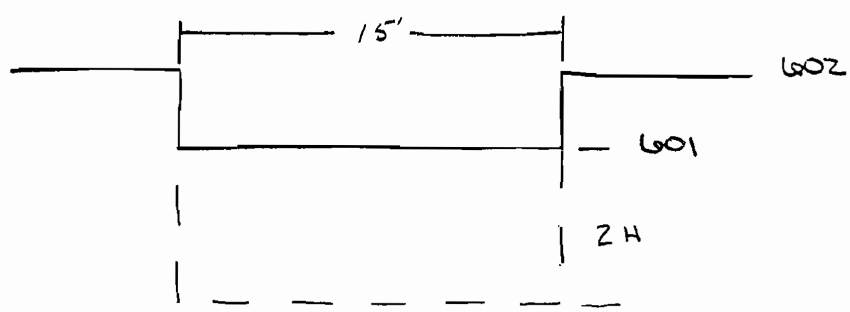
EQUATION FOR RECTANGULAR WIER

$Q = KLH^{1.5}$ $H = 1$ ft

cfs $Q = 3.367\,L\,(H^{1.5})$

$40.6 = 3.367(L)(1^{1.5})$

$L = 12'$ min. ✓



WIER $L = 15$ $H = 1$ ft

$Q = 3.367\,(15)(1^{1.5}) = \underline{\underline{50.5 \text{ cfs}}}$ ✓

Hydrology Calculations April 10, 2002
Vermilion Power Station
New Ash Pond

This hydrology calculation analyzes the maximum stage elevation in the new pond and maximum discharge in the 3' existing pipe due to a 100-yr. 7" rain storm in 24 hours.

This new ash pond will receive storm water runoff from the 34 acre coal yard. The runoff coefficient used for this coal yard is 0.2. The rational method equation is used to estimate the peak flow from the coal yard.

Q = kCiA where Q= peak flow (cfs), k = conversion factor equal to 1.008 (SI), C= 0.2, i= rainfall intensity = 7"/24-hr. , A = area of 34 acres

Q = 1.008 x 0.2 x 7/24 x 34
= 2 cfs

The runoff of 2 cfs will be added to plant flow of 2.5 cfs and the total flow of 4.5 cfs will be used as an input in the HEC-1 program, as the initial flow into the pond. The area of the pond to be used in the HEC-1 program will include the main pond of 20.6 acres plus the polishing pond of 2.1 acres, for a total area of 22.7 acres or 0.0355 sq. miles.

These calculations are intended for submittal to the Illinois Department of Natural Resources, Office of Water Resources for a construction permit. They have been prepared in accordance with the following Office of Water Resources publications:

1. **Rules for Construction and Maintenance of Dams**
2. **Procedural Guidelines for Preparation of Technical Data to be Included for Permits for Construction and Maintenance of Dams**

From the HEC-1 computer program, the following results were obtained.

Pond	100-yr., 24-hour storm max. elevation (feet)	max. discharge (cfs)
1	616.84	25

References used:

1. **Frequency Distributions of Heavy Rainstorms in Illinois,** Illinois State Water Survey, 1989.
2. **Effects of Basin Rainfall Estimates on Dam Safety Design in Illinois,** Illinois State Water Survey, Surface Water Division, 1981.

Stage-Discharge Relationship- New Pond at Vermilion Power Station

Weir Equation

Q = CLH^1.5
L= PI*D
C= 3.33

Input

D= dia. of standpipe = 36"
H= head increment

Comments	Stage (ft)	Head (ft)	Q (cfs)
elev. of standpipe	616.00	0.00	0.00
Channel flow	616.50	0.50	11.10
	617.00	1.00	31.38
pipe flow begins	617.50	1.50	57.66
Pipe flow	618.00	2.00	88.77
	618.50	2.50	124.06
	619.00	3.00	163.08
	619.50	3.50	205.50
	620.00	4.00	251.08

Normal pool elevation: 616'
Area at normal elevation: 19.64 acres = 855,381 sq. ft.

Max. pool elevation: 620'
Area at max. elevation: 20.62 acres = 898,163 sq. ft.

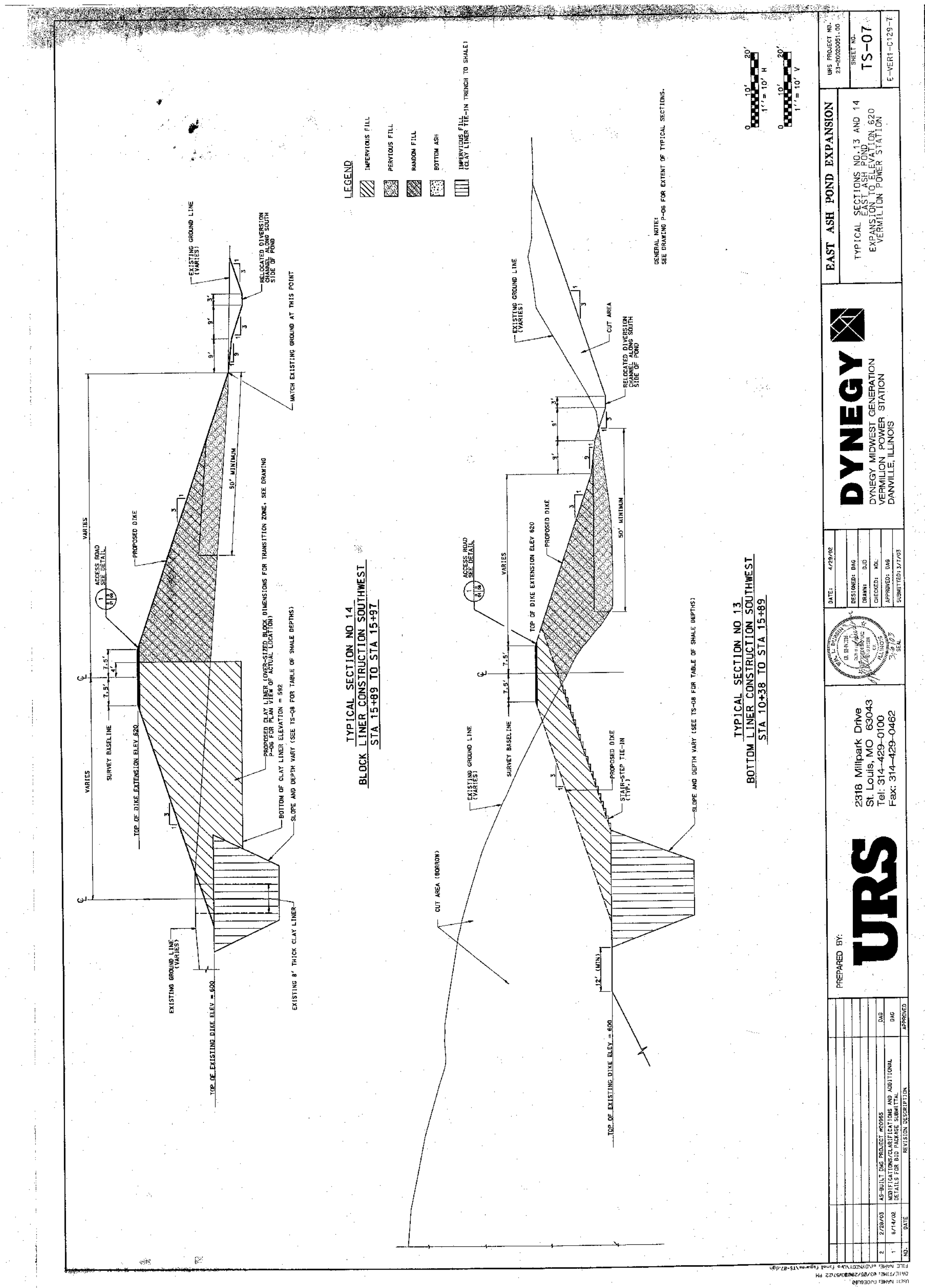
Stage-Storage Relationship- New Pond at Vermilion Power Station

Stage (ft)	Storage (acre-ft)	Water surface area (acres)
616.00	0.00	19.64
616.50	9.85	19.76
617.00	19.76	19.89
617.50	29.74	20.01
618.00	39.77	20.13
618.50	49.87	20.25
619.00	60.02	20.38
619.50	70.24	20.50
620.00	80.52	20.62

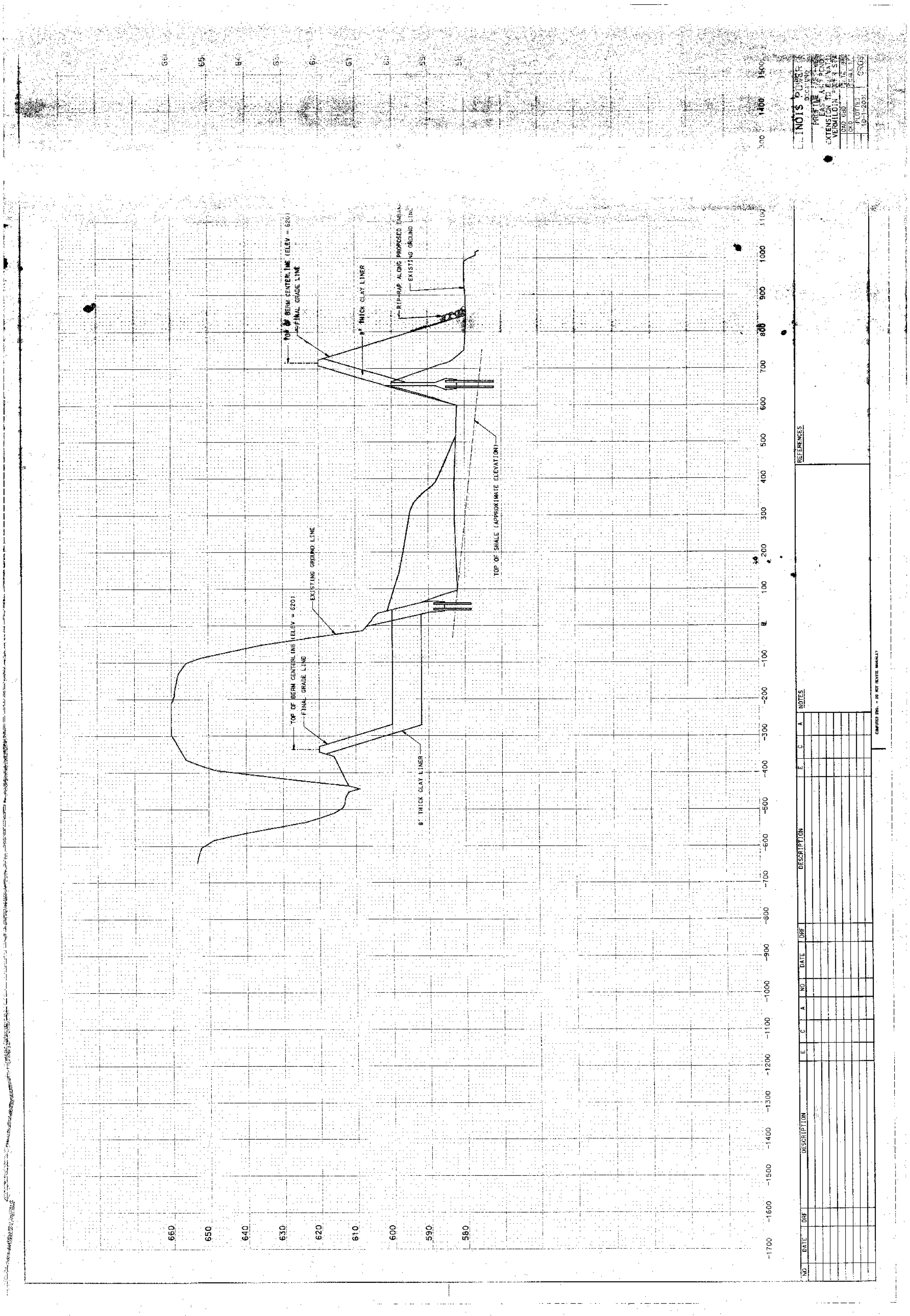
Normal pool elevation: 616'
Area at normal elevation: 19.64 acres = 855,381 sq. ft.

Max. pool elevation: 620'
Area at max. elevation: 20.62 acres = 898,164 sq. ft.

Document 17: East Ash Pond System Expansion Typical Sections 1 of 2



Document 18: East Ash Pond System Expansion Typical Sections 2 of 2



VERMILION EROSION PROJECT OVERVIEW

Date	Activity
Summer 2008	Four areas of erosion identified along the Middle Fork of the Vermillion River
October 2008	Informal discussions with USCOE and IDNR
October – December 2008	URS prepares gabion revetment design and associated specifications/plans, for one of four locations.
November 2008	Permit application submitted to USCOE
December 2008	IDNR visits site
January 2009	• Submitted addendum letter to USCOE and NPS and provided more details on gabion design, for one of the four locations of erosion. • IDNR forwards project to National Park Service 9NPS). NPS states that they have regulatory authority under the Wild and Scenic Rivers Act.
January and February 2009	Various informal correspondence between us and USCOE, NPS, IDNR (phone calls, e-mails)
March 2009	Formal correspondence from NPS, evaluating our design proposal. (Not considered a final determination letter). NPS is not receptive to gabion design.
April 2009	• USCOE requests more information on gabion design • USCOE/IDNR/NPS/OEC meet at plant to look at eroded areas and discuss gabion design. NPS is not receptive to gabion design and asks us to consider other designs. No consensus on design approach was reached.
June 2009	USCOE issues letter requesting a more detailed alternative analysis.
May and June 2009	Alternative design analysis completed with geomorphologist and e-mailed to USCOE/NPS. OEC now proposes a stream barb design.
July 2009	• Phone conversation with USCOE. USCOE states that they will not issue permit until NPS issues a "No Adverse Effect" letter. USCOE requests more design details on stream barb proposal. • Phone conversation with NPS. NPS indicates that gabion design will be rejected. NPS reserves right to reject stream barb design. NPS asks us to consider alternative methods for ash disposal (i.e. get away from using surface impoundments located so closely to the river)
July 2009	Internal meeting (Rick D., me, Tom D., Kipp, Chuck, Jeff Ferry, Andreas) to discuss this stalemate with NPS. Consensus reached to continue and look at other alternatives, that would be acceptable to the NPS. Discussed possibility of IDNR Director shooting letter to Hector's boss. Not sure that this would be effective.
July 2009	Via e-mail, NPS shot down gabion and stream barb design, saying that they are inconsistent with the Wild and Scenic Rivers Act. He wants more options. Unwilling to meet, at our request. Sent e-mail to NPS, requesting more guidance on what options he would accept. No response.

July 2009	Geomorphologist proposes a vegetated reinforced soil slope (VRSS) system.
July 2009	URS said: • VRSS system would be less effective than gabion. • Also, upper profiles would be ineffective to protect against erosion, at high water. • More risk of further erosion with VRSS, as compared to gabions.
July 2009	Discussed Vermilion erosion project with ERM. George Lynn proposed gabion mattresses and cabled concrete blocks.
August 2009	Louis Yockety called. Said IDNR was getting frustrated with NPS and, if Dynegy requested it, he would have IDNR Director shoot letter to Hector's boss, to expedite this situation.
August 2009	Sent e-mail to NPS (Hector), about his opinion on gabion mattress. No response.
August 2009	E-mail from NPS (Hector). Verbally disapproves of gabion mattress. Said his office would not approve caging.
August 2009	Conducted geomorphological study of river.
September 2009	Geomorphological study issued.
October and November 2009	Internal review of design options, proposed in geomorphological study, researched other soil bioengineering remedial approaches, and drafted revised design, for revised permit application
December 2009	Submitted revised permit application to USACOE/IDNR/NPS.
December 2009	Received e-mail feedback from IDNR, listing two pages of questions and requesting more details on our design. I called Louis Yockety to discuss. (I prefer to get NPS feedback, before any additional time/$$ is spent on answering IDNR questions and developing design).
March 2010	Follow-up e-mail to NPS, requesting status update. No response.

May 2010	@ 5/6 - E-mailed USCOE and NPS, asking them to expedite nationwide permit for location # 3 (crib house erosion). 5/11 - E-mailed photos of location # 3 (crib house erosion) to NPS and USCOE. 5/11 - E-mail from USCOE requesting more design information for location # 3 (material, length of repairs, amount of fill to be installed below the ordinary high water mark, associated design drawings). (I started putting together some preliminary design information. I will need to better evaluate extent of erosion along crib house foundation in Summer 2010, when river is very low.)
June 2010	6/1 – USCOE sends e-mail, checking to see if we have received any information from the NPS, regarding NPS' Section 7A determination letter authorizing our soil bioengineering design for location # 2. I responded no. 6/1 – USCOE follows-up with NPS, via e-mail. No response. 6/9 – USCOE follows-up with NPS, via e-mail. NPS responds by stating that they will "have it out by the end of the week". 6/21/10 – USCOE e-mails me to see if I have received anything from the NPS. I said no. 6/21/10 – USCOE follows-up with NPS, via e-mail, expressing the fact that the project has "gone way past the review time periods" ands "pressure from supervisor to make a decision on the project". No response.
July 2010	7/15 – USCOE follows-up with NPS, via e-mail. No response. 7/27 – Conducted visual inspection of locations # 1,2, and 3. River is very low. At location # 3, evidence of scouring behind the crib house is observed for the 1st time. Location # 1 has moved @ 8', over past 12 months (@ 145' from toe of north dam). Location # 2 has moved @ 2', in areas, over past 12 months (@75' from toe of east dam. 7/29 – USCOE follows-up with NPS, via e-mail. No response.
August 2010	Sent photos of crib house erosion to URS. Discussions/e-mails with URS, regarding their assistance with assembling design data / drawings for crib house, to respond the May 2010 request from USCOE for design information.

DYNEGY MIDWEST GENERATION, INC.

Vermilion Power Station

Oakwood, Illinois

East Ash Pond System

Intermediate Class III Dam

IDNR Permit No. DS2002056

Dam ID No. IL50291

Operation and Maintenance Plan

December 2009

TABLE OF CONTENTS

DYNEGY MIDWEST GENERATION, INC.
VERMILION POWER STATION
IDNR CLASS III DAM OPERATION AND MAINTENANCE PLAN

1.0 GENERAL

The following maintenance procedures are provided to insure the structural integrity of the Vermilion wet ash disposal facility, which is classified as an Intermediate Class III dam by the Illinois Department of Natural Resources, Office of Water Resources (OWR).

2.0 EMERGENCY OPERATIONS

2.1 Unusual Conditions

Any unusual condition discovered during routine inspection which may constitute an emergency shall be handled as follows. Notice of any type of emergency involving the berms or outfall shall be made to the Shift Leader on duty (217) 354-2141. The Shift Leader on duty shall notify the following: Production Manager, Jack Antonini

office:	(217) 354-3042
home:	(217) 431-5344
cellular phone:	(217) 781-2344
24-hr. pager:	jack.antonini@dynegy.com

or

Plant Manager, James R. (Bob) Kipp

office:	(217) 354-3020
home:	(217) 586-1613
cellular phone:	(217) 841-8315
blackberry:	james.r.kipp@dynegy.com

One of the above designated personnel shall notify the following county, state, and federal regulatory authorities, and the consulting engineer of the emergency condition.

Office of Water Resources, Dam Safety Section, Dam Safety Engineers
(217) 782-3863 (Monday - Friday, 8:00 a.m. - 4:30 p.m.)

Illinois Emergency Management Agency, 24-hour service
1-(800) 782-7860

Vermilion County Sheriff
Emergency 911 or (217) 442-4080

Illinois Department of Natural Resources, Kickapoo State Park
(217) 442-4915

Manager - Operations Environmental Compliance – Rick Diericx
(618) 206-5912 or Rick.Diericx@dynegy.com

2.2 Dewatering

The Plant Manager or the Production Manager shall have the responsibility of determining whether dewatering of the disposal facility is necessary. A gravity outlet structure is located at the facility. The valve to this structure can be opened to lower the water level. This dewatering shall continue until the desired water level is reached.

3.0 MAINTENANCE

3.1 Vegetation

Berms shall be maintained to protect the structural integrity of the disposal facility. Damaged and barren areas shall be repaired as soon as appropriate after being discovered. Damaged areas shall be filled with topsoil, limed, fertilized, and seeded with appropriate vegetation. Trees and shrubs observed during semiannual inspections shall be cut and removed from the berms and outfall channel. This shall be done frequently enough that no trees will reach the size where the root structure would require removal and filling. Woody vegetation, shrubs, and trees shall be removed during the early stages of growth before reaching a three-inch diameter.

Low growing vegetation that will facilitate inspections shall be planted and maintained.

3.2 Effluent Discharge Canal

The effluent discharge canal shall be inspected semiannually and repaired as needed. Any replacement of riprap shall be done in a timely manner.

3.3 Animal Damage and Repairs

Animal burrows discovered during inspections shall be promptly repaired by filling with grout.

3.4 Restriction of Unauthorized Vehicles

Access to the ash pond site area is controlled by the main plant access gate. No unauthorized vehicles are allowed into the site area.

3.5 Inspections

Because the site is probably undermined by coal workings, there is potential for mine-induced subsidence and damage to the embankment. Therefore, the routine inspections are needed to document the condition of the embankment and potential subsidence related damage.

Indications of subsidence would include settlement of the crest, sloughing of embankments or formation of depressions near the toe. If such conditions are observed either during the quarterly and qualified station employee inspection or the once every five year registered professional engineer (PE) inspection, and those conditions are judged to pose an imminent threat to the integrity of the embankment, the notifications described in Section 2.1 of this plan shall be made.

If the observed conditions are not judged by the trained station employee or professional engineer to pose an imminent threat, the Station Manager or Production Manager, and the Dynegy Manager of Operations Environmental Compliance shall be contacted. These individuals will then meet to develop a plan to evaluate the cause of the distress and any further action required. IDNR will be informed of the condition and any proposed remediation.

The inspections by the qualified station employee shall be conducted on a quarterly basis and documented on the inspection report form enclosed as **Exhibit 1.** These reports shall be provided to the PE, as part of the PE 5-year inspection interval.

All inspections by the PE shall include observations of the embankment surfaces for signs of settlement or slope failure, animal burrows, tree growth, erosion features on or adjacent to the embankments, and the conditions of the discharge facilities.

The inspections by the PE shall be done in general accordance with "Guidelines and Forms for Inspection of Illinois Dams", 1987 using the standard forms approved by the IDNR.

Any deficiencies noted by the PE warranting remedial actions shall be reported to the Production Director for the Station. The Production Director shall implement corrective action as required to assure dam safety. Copies of the PE's reports shall be provided to the Illinois Department of Natural Resources, Office of Water Resources.

4.0 Reporting

The quarterly and qualified station employee inspections shall utilize **exhibit 1.** and filed on-site. These inspection reports shall be made available to an IDNR field inspector if requested. The report of the inspection performed every December by the PE, (on a five year cycle), shall be sent to the IDNR office in Springfield, IL.

Exhibit 1

Vermilion Power Station
East Ash Pond System
Potential Subsidence Special Inspection Form (Quarterly Inspection)

Dam Location: Vermilion Power Station; Vermilion County; Pilot Township

Owner: Dynegy Midwest Generation, Inc; Vermilion Power Station

Permit No.: DS2002056 **Class of Dam:** Intermediate III

Type of Dam: Earth Embankment for Ash Impoundment

Type of Spillway: **Drop Inlet for Primary and Secondary Ponds**

Date Inspected: ______________________

Weather Conditions: ____

Pool Elevation: ______________________

Inspection Personnel:

____________________________________ ________________________

Name **Title**

____

Signature

Exhibit 1

Vermilion Power Station
East Ash Pond System
Potential Subsidence Special Inspection Form (Quarterly Inspection)

Page 2 of 2

Inspection Item	Conditions	Location of Problem and Recommended Remedial Measures and Implementation Schedule
Vertical and Horizontal Alignment of Crest		
Downstream Fill Slopes		
Upstream Fill Slopes		
Cut Slopes		
Unusual Movement or Cracking at or Beyond Toe		
Seepage		
Vegetative Cover		
Animal Damage		
Embankment Erosion		
Water Passages		
Structural Cracking		
Other		
Other		

Inspector:_______________________________________ **Date:** _________________

Dam Inspection Report

Name of Dam Vermilion PS, East Ash Disposal Facility **Dam ID No.** IL 50291

Permit Number DS2002056 **Class of Dam** III

Location SE 1/4 **Section** 20 **Township** 20N **Range** 12 W. of 2nd P.M.

Owner Dynegy Midwest Generation
Name

217-354-2141
Telephone Number (Day)

P.O. Box 250
Street

217-354-2141 x250
Telephone Number (Night)

Oakwood, IL 61858
City **Zip Code**

County Vermilion

Type of Dam Earthen Embankment

Type of Spillway Drop inlet for both Primary and Secondary Cells

Date(s) Inspected February 13, 2009

Weather When Inspected Sunny with winds 10-20 mph

Temperature When Inspected 40 degrees F

Pool Elevation When Inspected 588

Tailwater Elevation When Inspected NA

Inspection Personnel:

Name	Title
Kenneth M Berry, P.E.	Sr Proj Engr (URS)
Thomas L. Davis, P.E.	Sr EnvironmentalEngr

KENNETH MONROE BERRY
062-051918
REGISTERED PROFESSIONAL ENGINEER
STATE OF ILLINOIS

Kenneth M Berry
7/15/09

Professional Engineer's Seal

The Department of Natural Resources is requesting information that is necessary to accomplish the statutory purpose as outlined under the River, Lakes and Streams Act, 615 ILCS 5. Submittal of this information is REQUIRED. Failure to provide the required information could result in the initiation of non.-compliance procedures as outlined in Section 3702.160 of the "Rules for Construction and Maintenance of Dams.

CONDITION CODES

NE - **No evidence of a problem**

GC - **Good condition**

MM - **Item needing minor maintenance and/or repairs within the year, the safety or integrity of the item is not yet imperiled**

IM - **Item needing immediate maintenance to restore or ensure its safety or integrity**

EC - **Emergency condition which if not immediately repaired or other appropriate measures taken could lead to failure of the dam**

OB - **Condition requires regular observation to ensure that the condition does not become worse**

NA - **Not applicable to this dam**

NI - **Not inspected -list the reason for non-inspection under deficiencies**

Terminology for this report:

P = Primary Cell

S = Secondary Cell

Need to review O&M Plan annually.

EARTH EMBANKMENT

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Surface Cracks	NE	NA	
Vertical and Horizontal Alignment of Crest	GC	NA	
Unusual Movement or Cracking' At or Beyond Toe	NE	NA	
Sloughing or Erosion of Embankment and Abutment Slopes	GC	NA	
Upstream Face Slope Protection	GC	NA	
Seepage	NE	NA	
Filter and Filter Drains	P – GC S - NA	NA	

EARTH EMBANKMENT
(Continued)

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Animal Damage	NE	NA	
Embankment Drainage Ditches	P – GC S - NA	NA	
Vegetative Cover	MM	MM	There are some small saplings sporadically along embankment. These should be sprayed (do not kill grass) or cut. Thin vegetation at SE corner should be observed that it fills in.
Other (Name)	NA		
Other	NA		
Other	NA		
Other	NA		

CONCRETE OR MASONRY DAMS

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Seepage	NA		
Structure to Abutment! Embankment Junctions	NA		
Water Passages	NA		
Foundation	NA		
Surface Cracks in Concrete Surfaces	NA		
Structural Cracking	NA		
Vertical and Horizontal Alignment	NA		

CONCRETE OR MASONARY DAMS
(CONTINUED)

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Monolith Joints	NA		
Contruction Joints	NA		
Spalling of Concrete	NA		
Filters; Drains, etc.	NA		
Riprap	NA		
Other (Name)	NA		

IF THE DAM IS GATED – Fill out the portion of the Principal Spillway Form related to Gated Spillways

PRINCIPAL SPILLWAY
APPROACH CHANNEL

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Debris	NA		
Side Slope Stability	NA		
Slope Protection	NA		
Other (Name)	NA		
Other	NA		
Other	NA		
Other	NA		

PRINCIPAL SPILLWAY

x Drop Inlet Spillway ☐ Overflow Spillway Structure ☐ Gated

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	NE	NA	
Structure to Embankment Junction	GC	NA	
Drains	NA	NA	
Seepage Around or Into Structure	P - NI S - NE	P – Inlet is out in pond without access S - NA	
Surface Cracks	NE	NA	
Structural Cracks	NE	NA	

IF THE SPILLWAY IS GATED FILL OUT THE SPILLWAY SECTION

PRINCIPAL SPILLWAY
(Continued)

x Drop Inlet Spillway ☐ Overflow Spillway Structure ☐ Gated

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Alignment of Abutment Walls	NA	NA	
Construction Joints	NI – under water	NA	
Filter and Filter Drains	NA	NA	
Trash Racks	NA	NA·	
Bridge and Piers	GC	NA	(P- secondary outlet, S – primary outlet)
Differential Settlement	NE	NA	
Other (Name)	NA	NA	

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

PRINCIPAL SPILLWAY
(Continued)

x Conduit ☐ Gated

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	NI	Underwater	
Joint Separation	NI	Underwater	
Seepage Around of Into Conduit	NI	Underwater	
Surface Cracks	NI	Underwater	
Structural Cracks	NI	Underwater	
Trash Racks	NA	NA	
Differential Settlement	NE	NA	
Alignment	GC	NA	
Other (Name) Effluent Pipe	NA	NA	

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

PRINCIPAL SPILLWAY
(Continued)

☐ Chute

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	NA		
Structure to Embankment Junction	NA		
Construction Joints	NA		
Expansion and Contraction Joints	NA		
Differential Settlement	NA		
Surface Cracks	NA		
Structural Cracks	NA		
Wall Alignment	NA		
Other (Name)	NA		

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

PRINCIPAL SPILLWAY

☐ Principal Spillway ☐ Dewatering ☐ Other:

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Gate Sill	NA		
Gate Seals	NA		
Gate and Frame	NA		
Operating Machinery	NA		
Emergency Operating Machinery	NA		
Other (Name)	NA		
Other	NA		

OUTLET WORKS
IF SEPARATE FROM PRINCIPAL SPILLWAY STRUCTURE

ITEM	CONDITION CODE'	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion. Spalling, Cavitation	NA		
Joint Separation	NA		
Seepage Around or Into Conduit	NA		
Intake Structure	NA		
Outlet Structure	NA		
Outlet Channel	NA		
Riprap	NA		
Other (Name)	NA		
Other	NA		

ENERGY DISSIPATOR

☐ Principal Spillway   x Outlet Works

Type:

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	NE	NA	
Structure to Embankment Junction	NE	NA	
Construction Joints	NE	NA	
Surface Cracks	NE	NA	
Structural Cracks	NE	NA	
Differential Alignment	NE	NA	
Expansion and Contraction Joints	NA	NA	

ENERGY DISSIPATOR
(Continued)

☐ Principal Spillway x Outlet Works

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Riprap	GC	NA	
Outlet Channel	GC	NA	
Debris	NE	NA	
Other (Name)	NA		
Other	NA		
Other	NA		
Other	NA		

EMERGENCY SPILLWAY

☐ Earth ☐ Other: Name ________

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion	NA		
Weeds, Logs. Other Obstructions	NA		
Side Slope Sloughing	NA		
Vegetation	NA		
Sedimentation	NA		
Riprap	NA		
Settlement of Crest	NA		
Downstream Channel	NA		
Other (Name)	NA		

SUMMARY OF MAINTENANCE DONE AND/OR

REPAIRS MADE SINCE THE LAST INSPECTION

DATE OF PRESENT INSPECTION February 13, 2009

DATE OF LAST INSPECTION December 3, 2007

1. EARTH EMBANKMENT DAMS

Misc. maintenance including seeding and routine mowing.

2. CONCRETE MASONARY DAMS

3. PRINCIPAL SPILLWAY

4. OUTLET WORKS

5. EMERGENCY SPILLWAY

DOWNSTREAM DEVELOPMENT
APPROXIMATE WIDTH OF AFFECTED FLOODPLAIN ___0.2___ MILES.

MILES DOWNSTREAM FROM DAM	DOWNSTREAM DEVELOPMENT												Loss Of Life Potential			Economic Loss Potential			SKETCH IN DEVELOPMENTS DOWNSTREAM OF THE DAM
	OCCUPIED HOMES	UNOCCUPIED HOMES	AGRICULTURAL BUILDINGS	INDUSTRIAL BUILDINGS	COMMERCIAL BUILDINGS	SCHOOLS	HOSPITALS	ROADS & BRIDGES	DAMS	OVERHEAD UTILITIES	OTHER DEVELOPMENT (Name)	OTHER DEVELOPMENT (Name)	NONE	1 TO 10	OVER 10	MINIMAL EXPECTED	APPRECIABLE EXPECTED	EXCESSIVE EXPRECTED	
0 to ¼	0	0	0	0	0	0	0	0	0	0	0	0	x			x			
¼ to ½													x			x			
½ to ¾													x			x			
¾ to 1													x			x			
1 to 1 ¼													x			x			
1 ¼ to 1 ½													x			x			
1 ½ to 1 ¾													x			x			
1 ¾ to 2													x			x			
OVER 2													x			x			

The number of homes, buildings, or other items in the floodplain downstream of the dam should be placed in the appropriate row and column to designate their location.

Owner's Maintenance Statement

I, James R. Kipp ____________, owner of Vermilion PS East Ash Disposal System dam,

Dam Identification Number IL 50291 ________, in Vermilion County,

am maintaining the dam in accordance with the accepted maintenance plan

which is part of Permit Number DS2002056 ________________.

____
Signature

____
Date

Owner's Operation and Maintenance Plan Statement

I, James R. Kipp ____________, owner of Vermilion PS East Ash Disposal System dam,

Dam Identification Number IL 50291 ________, in Vermilion ______ County,

have reviewed the operation and maintenance plan including the Emergency

Action Plan (EAP), which is part of Permit Number DS2002056 ________.

I ☐ have enclosed the appropriate revisions or

☐ have determined that no revisions to the plan are necessary.

____
Signature

____
Date

The Department of Natural Resources is requesting information that is necessary to accomplish the statutory purposes as outlined under the River, Lakes and Streams Act, 615 IL CS 5. Submittal of this information is REQUIRED. Failure to provide the required information could result in the initiation on non-compliance procedures as outlined in Section 3702.160 of the "Rules for Construction and Maintenance of Dams."

Dam Inspection Report

Name of Dam Vermilion PS, East Ash Disposal Facility **Dam ID No.** IL 50291

Permit Number DS2002056 **Class of Dam** III

Location SE 1/4 **Section** 20 **Township** 20N **Range** 12 W. of 2nd P.M.

Owner Dynegy Midwest Generation
Name

217-354-2141
Telephone Number (Day)

P.O. Box 250
Street

217-354-2141 x250
Telephone Number (Night)

Oakwood, IL 61858
City **Zip Code**

County Vermilion

Type of Dam Earthen Perimeter Embankment – North, East and South Sides

Type of Spillway 2 Drop inlets for Primary Cell and 1 Drop inlet for Secondary Cell

Date(s) Inspected March 30, 2010

Weather When Inspected Sunny

Temperature When Inspected 60 degrees F

Pool Elevation When Inspected 588

Tailwater Elevation When Inspected NA

Inspection Personnel:

Kenneth M Berry, P.E. Sr Proj Engr (URS)
Name **Title**

Phil L. Morris, P.E. Environmental Professional
Name **Title**

KENNETH MOMS OF BERRY 0062-051918 REGISTERED PROFESSIONAL ENGINEER STATE OF ILLINOIS

Kenneth M Berry
5/21/10

Name **Title**

Professional Engineer's Seal

Name **Title**

The Department of Natural Resources is requesting information that is necessary to accomplish the statutory purpose as outlined under the River, Lakes and Streams Act. 615 ILCS 5. Submittal of this information is REQUIRED. Failure to provide the required information could result in the initiation of non.-compliance procedures as outlined in Section 3702.160 of the "Rules for Construction and Maintenance of Dams.

CONDITION CODES

NE - No evidence of a problem

GC - Good condition

MM - Item needing minor maintenance and/or repairs within the year, the safety or integrity of the item is not yet imperiled

IM - Item needing immediate maintenance to restore or ensure its safety or integrity

EC - Emergency condition which if not immediately repaired or other appropriate measures taken could lead to failure of the dam

OB - Condition requires regular observation to ensure that the condition does not become worse

NA - Not applicable to this dam

NI - Not inspected -list the reason for non-inspection under deficiencies

---

Terminology for this report:

P = Primary Cell

S = Secondary Cell

Need to review O&M Plan annually.

EARTH EMBANKMENT

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Surface Cracks	NE	NA	
Vertical and Horizontal Alignment of Crest	GC	NA	
Unusual Movement or Cracking' At or Beyond Toe	NE	NA	
Sloughing or Erosion of Embankment and Abutment Slopes	GC	NA	
Upstream Face Slope Protection	GC	NA	No rip rap slope protection. Slope covered with grass. Erosion not observed.
Seepage	NE	NA	
Filter and Filter Drains	P – NE S - NA	NA	Primary Cell contains internal drains which cannot be visually inspected.

EARTH EMBANKMENT
(Continued)

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Animal Damage	NE	NA	
Embankment Drainage Ditches	P – GC S - NA	NA	
Vegetative Cover	NE	NA	
Other –Face of slope	OB	OB	Vehicle tracks observed on face of slope. Limit traffic to only mowing equipment.
Other	NA		
Other	NA		
Other	NA		

CONCRETE OR MASONRY DAMS

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Seepage	NA		
Structure to Abutment Embankment Junctions	NA		
Water Passages	NA		
Foundation	NA		
Surface Cracks in Concrete Surfaces	NA		
Structural Cracking	NA		
Vertical and Horizontal Alignment	NA		

CONCRETE OR MASONARY DAMS
(CONTINUED)

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Monolith Joints	NA		
Contruction Joints	NA		
Spalling of Concrete	NA		
Filters; Drains, etc.	NA		
Riprap	NA		
Other (Name)	NA		

IF THE DAM IS GATED – Fill out the portion of the Principal Spillway Form related to Gated Spillways

PRINCIPAL SPILLWAY
APPROACH CHANNEL

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Debris	NA		
Side Slope Stability	NA		
Slope Protection	NA		
Other (Name)	NA		
Other	NA		
Other	NA		
Other	NA		

PRINCIPAL SPILLWAY

x Drop Inlet Spillway ☐ Overflow Spillway Structure ☐ Gated

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	NE	NA	
Structure to Embankment Junction	NE	NA	
Drains	NA	NA	
Seepage Around or Into Structure	P - NI S - NE	P – Inlet is out in pond without access S - NA	
Surface Cracks	NE	NA	
Structural Cracks	NE	NA	

IF THE SPILLWAY IS GATED FILL OUT THE SPILLWAY SECTION

PRINCIPAL SPILLWAY
(Continued)

x Drop Inlet Spillway ☐ Overflow Spillway Structure ☐ Gated

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Alignment of Abutment Walls	NA	NA	
Construction Joints	NI – under water	NA	
Filter and Filter Drains	NA	NA	
Trash Racks	NA	NA·	
Bridge and Piers	P-NA S-GC	NA	
Differential Settlement	NE	NA	
Other (Name)	NA	NA	

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

PRINCIPAL SPILLWAY
(Continued)

x Conduit ☐ Gated

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	NI	Underwater	
Joint Separation	NI	Underwater	
Seepage Around of Into Conduit	NI	Underwater	
Surface Cracks	NI	Underwater	
Structural Cracks	NI	Underwater	
Trash Racks	NA	NA	
Differential Settlement	NI	NA – Buried. No internal inspection.	
Alignment	NI	NA – Buried. No internal inspection.	
Other (Name) Effluent Pipe	NA	NA	

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

PRINCIPAL SPILLWAY
(Continued)

☐ Chute

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	NA		
Structure to Embankment Junction	NA		
Construction Joints	NA		
Expansion and Contraction Joints	NA		
Differential Settlement	NA		
Surface Cracks	NA		
Structural Cracks	NA		
Wall Alignment	NA		
Other (Name)	NA		

IF THE SPILLWAY IS GATED FILL OUT THE GATES SECTION

PRINCIPAL SPILLWAY

☐ Principal Spillway ☐ Dewatering ☐ Other:

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Gate Sill	NA		
Gate Seals	NA		
Gate and Frame	NA		
Operating Machinery	NA		
Emergency Operating Machinery	NA		
Other (Name)	NA		
Other	NA		

OUTLET WORKS
IF SEPARATE FROM PRINCIPAL SPILLWAY STRUCTURE

ITEM	CONDITION CODE'	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion. Spalling, Cavitation	NA		
Joint Separation	NA		
Seepage Around or Into Conduit	NA		
Intake Structure	NA		
Outlet Structure	NA		
Outlet Channel	NA		
Riprap	NA		
Other (Name)	NA		
Other	NA		

ENERGY DISSIPATOR

☐ Principal Spillway x Outlet Works

Type:

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	NE	NA	
Structure to Embankment Junction	NE	NA	
Construction Joints	NE	NA	
Surface Cracks	NE	NA	
Structural Cracks	NE	NA	
Differential Alignment	NE	NA	
Expansion and Contraction Joints	NA	NA	

ENERGY DISSIPATOR
(Continued)

☐ Principal Spillway x Outlet Works

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Riprap	GC	NA	
Outlet Channel	GC	NA	
Debris	NE	NA	
Other (Name)	NA		
Other	NA		
Other	NA		
Other	NA		

EMERGENCY SPILLWAY

☐ Earth ☐ Other: Name ____________

ITEM	CONDITION CODE	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion	NA		
Weeds, Logs. Other Obstructions	NA		
Side Slope Sloughing	NA		
Vegetation	NA		
Sedimentation	NA		
Riprap	NA		
Settlement of Crest	NA		
Downstream Channel	NA		
Other (Name)	NA		

SUMMARY OF MAINTENANCE DONE AND/OR

REPAIRS MADE SINCE THE LAST INSPECTION

DATE OF PRESENT INSPECTION March 30, 2010

DATE OF LAST INSPECTION February 13, 2009

1. EARTH EMBANKMENT DAMS

Misc. maintenance including seeding and routine mowing.

2. CONCRETE MASONARY DAMS

3. PRINCIPAL SPILLWAY

4. OUTLET WORKS

5. EMERGENCY SPILLWAY

DOWNSTREAM DEVELOPMENT
APPROXIMATE WIDTH OF AFFECTED FLOODPLAIN ___0.25___ MILES.

MILES DOWNSTREAM FROM DAM	DOWNSTREAM DEVELOPMENT												Loss Of Life Potential			Economic Loss Potential			SKETCH IN DEVELOPMENTS DOWNSTREAM OF THE DAM
	OCCUPIED HOMES	UNOCCUPIED HOMES	AGRICULTURAL BUILDINGS	INDUSTRIAL BUILDINGS	COMMERCIAL BUILDINGS	SCHOOLS	HOSPITALS	ROADS & BRIDGES	DAMS	OVERHEAD UTILITIES	OTHER DEVELOPMENT (Name)	OTHER DEVELOPMENT (Name)	NONE	1 TO 10	OVER 10	MINIMAL EXPECTED	APPRECIABLE EXPECTED	EXCESSIVE EXPRECTED	
0 to ¼	0	0	0	0	0	0	0	0	0	0	0	0	x			x			
¼ to ½													x			x			
½ to ¾													x			x			
¾ to 1													x			x			
1 to 1 ¼													x			x			
1 ¼ to 1 ½													x			x			
1 ½ to 1 ¾													x			x			
1 ¾ to 2													x			x			
OVER 2													x			x			

The number of homes, buildings, or other items in the floodplain downstream of the dam should be placed in the appropriate row and column to designate their location.

Owner's Maintenance Statement

I, James R. Kipp ____________, owner of Vermilion PS East Ash Disposal System dam,

Dam Identification Number IL 50291 ________, in Vermilion ____ County,

am maintaining the dam in accordance with the accepted maintenance plan

which is part of Permit Number DS2002056 ____________________.

____
Signature

____
Date

Owner's Operation and Maintenance Plan Statement

I, James R. Kipp ____________, owner of Vermilion PS East Ash Disposal System dam,

Dam Identification Number IL 50291 ________, in Vermilion ______ County,

have reviewed the operation and maintenance plan including the Emergency

Action Plan (EAP), which is part of Permit Number DS2002056 ____________.

I ☐ have enclosed the appropriate revisions or

☐ have determined that no revisions to the plan are necessary.

____
Signature

____
Date

The Department of Natural Resources is requesting information that is necessary to accomplish the statutory purposes as outlined under the River, Lakes and Streams Act, 615 IL CS 5. Submittal of this information is REQUIRED. Failure to provide the required information could result in the initiation on non-compliance procedures as outlined in Section 3702.160 of the "Rules for Construction and Maintenance of Dams."

APPENDIX B PHOTOGRAPHS

East Ash Pond System

Inlet Pipes

Primary Pond Emergency Spillway

Primary Pond Principal Spillway

Primary Pond Principal Spillway

Primary Pond Typical Downstream Slope

Primary Pond Rip Rap on Downstream Toe

Primary Pond Rip Rap on Downstream Toe

Primary Pond Typical Downstream Slope

Primary Pond Typical Downstream Slope

Primary Pond Typical Downstream Slope

Primary Pond Typical Upstream Slope

Primary Pond Typical Downstream Slope

Primary Pond Typical Upstream Slope

Primary Pond Typical Upstream Slope

Primary Pond Typical Upstream Slope

Primary Pond

Primary Pond

Primary Pond Typical Upstream Slope

Primary Pond Typical Upstream Slope

Primary Pond Typical Crest

Primary Pond Settlement Marker

Secondary Pond

Secondary Pond Upstream Slope

Secondary Pond Outlet Structure – Four V-notched morning glory type looking down

Secondary Pond Outfall Structure

Secondary Pond Outfall Structure and downstream channel

North Ash Pond System

Secondary Pond

Secondary Pond Typical Upstream Section

Secondary Pond Typical Downstream Section

Secondary Pond Outlet Structure

Site Name:	**Vermillion Power Station**	Date:	**8/10/2010**
Unit Name:	**New East Ash Pond System**	Operator's Name:	**Dynegy Midwest Generation, Inc.**
Unit I.D.:		Hazard Potential Classification:	**High** ☐ **Significant** ☐ **Low** ☒ **Class 3-Intermediate (size)**
Inspector's Name:	Cleighton Smith, PE and Julia Moline, EIT		

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	X		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	600' primary/ 591' secondary		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	600'/591'		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?		NA	Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	620'		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?		X	Is water exiting outlet flowing clear?	X	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below)[2]:		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	X		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?	X		From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		NA	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?		X
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
1	PE inspections annually. Plant staff inspections monthly and quarterly, with weekly site visits.
12	Skimmers, not trash racks
21	Difficult to monitor seepage in downstream areas because of vegetation at the toe; portions of the toe we saw showed no signs of seepage

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit IL0004057; issued 3/7/2003; expired 2/28/2008 (renewal has been filed; hasn't been reissued)

INSPECTOR Cleighton Smith, PE

Date 8/10/2010
Impoundment Name New East Ash Pond Unit

Impoundment Company Dynegy
EPA Region 5

State Agency (Field Office) Address Illinois DNR
Name of Impoundment New East Ash Pond Unit

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☒ **Update** ☐

	Yes	**No**
Is impoundment currently under construction?	☐	☒
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: Handling of coal combustion waste

Nearest Downstream Town Name: Danville

Distance from the impoundment: 10 miles

Location:

Latitude	40	Degrees	10	Minutes	47.2938	Seconds	**N**
Longitude	87	Degrees	45	Minutes	7.8474	Seconds	**W**

State Illinois **County** Vermilion

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Illinois DNR

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☒ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

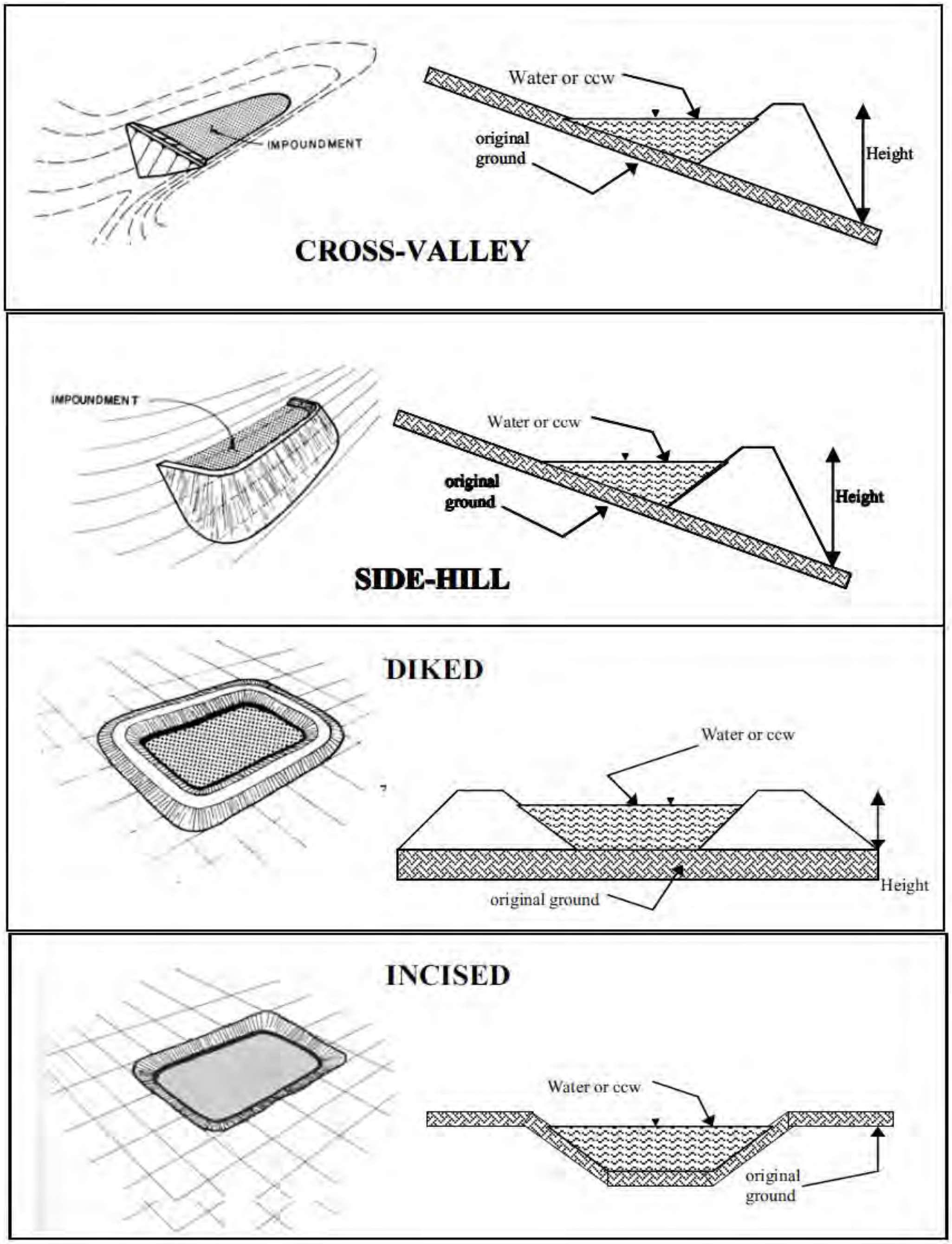
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

No residences or other development anywhere near dam. Failure could result in release of hazardous substances and therefore cause some environmental losses.

CONFIGURATION:



☐ Cross-Valley ☐ Side-Hill ☒ Diked (ring)

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	40’	**Embankment Material**	Minimum 8’ clay core surrounded by compacted earth
Pool Area (ac)	Unknown—requested information	**Liner**	None
Current Freeboard (ft)	29’ (crest is 620’, water is 591’→29’)	**Liner Permeability**	NA

TYPE OF OUTLET (Mark all that apply)

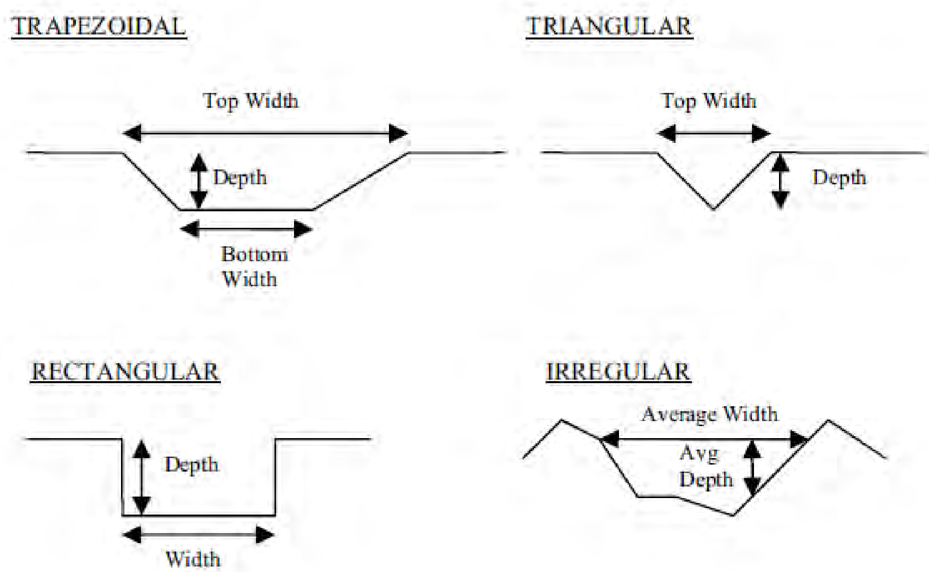
☒ **Open Channel Spillway**

- ☒ Trapezoidal
- ☐ Triangular
- ☐ Rectangular
- ☐ Irregular

depth (ft)

average bottom width (ft)

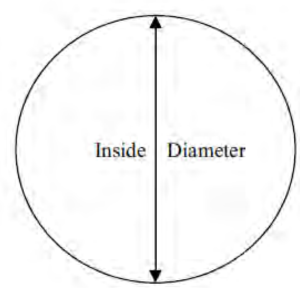
top width (ft)



☒ **Outlet**

36" inside diameter

concrete pipe that leads to the spillway channel



Material

- ☐ corrugated metal
- ☐ welded steel
- ☒ Concrete
- ☐ plastic (hdpe, pvc, etc.)
- ☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☒

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By	**Illinois Power Company, 1988; expanded designed by URS in 2002**

	Yes	No
Has there ever been a failure at this site?	☐	☒

If So When?

If So Please Describe :

	Yes	No
Have there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

No, not built over unsuitable materials (applies to original construction and expansion).

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

No, not of original design. Yes—representative of Engineer of Record for expansion present at time of assessment.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

No.